Confluence Parkway
Preliminary Stormwater Report

Prepared for:

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1. Introduction

Confluence Parkway is a new bypass corridor project being proposed in Wenatchee, Chelan County, Washington. The proposed project consists of a 2.5-mile, two-lane arterial street beginning on Euclid Avenue just north of Penny Road and extending south to Miller Street, with a new bridge over the Wenatchee River (see Figure 1 – Vicinity Map). The parkway would have one 11-foot wide travel lane in each direction with other features, such as left-turn pockets, sidewalks, and pedestrian/bicycle facilities, varying by location.

Stormwater improvements will be constructed to provide drainage for the completed roadway and address stormwater management requirements of the February 2019 *Stormwater Management Manual for Eastern Washington* (SWMMEW) and Wenatchee City Code (WCC) Chapter 9.20.

This report documents preliminary stormwater analysis and design performed in support of a National Environmental Policy Act (NEPA) Environmental Assessment for Confluence Parkway north of Hawley Street and south of Walla Walla Avenue (see Figure 2). This effort included an analysis of existing drainage conditions, stormwater management requirements, and alternative facility types and locations needed to comply with stormwater management requirements. Final stormwater design will be documented in a separate Stormwater Site Plan report.

This report does not address projects within the North Wenatchee Master Plan area that will undergo a separate environmental review process, including the proposed extension of McKittrick Street with a new railroad underpass and intersection at North Miller Street and Hawley Street.

2. Existing Drainage Conditions

2.1 Drainage Basins

Six drainage basins have been delineated within the project area based on downstream discharge points (Basins A- G, see Figure 2). These drainage basins are summarized as follows:

- **Basin A** consists of approximately 7 acres of the project area within City of Wenatchee Basin M-700 that discharge to the Columbia River at a 48-inch outfall near the north end of Walla Walla Point Park. The basin includes portions of N Miller Street south of Maple Street, which is developed urban streets with curbs, gutters and catch basins.
- **Basin B** consists of a 7-acre area along N Wenatchee Avenue at the intersection with Maple Street and N Miller Street that is within City of Wenatchee Basin M-500. This area discharges to the Columbia River via the 48-inch, 5th Street outfall.
- **Basin C** consists of approximately 2 acres of the project area that drain into the southern portion of the Horan Natural Area via the 36-inch No. 1 Canyon Drain outfall and ditch system. This basin includes a portion of Hawley Street where existing curbs and gutter drain to catch basins connected to the No. 1 Canyon Drain.

- **Basin D** consist of approximately 9 acres of the project area that drain into the central and northern portion of the Horan Natural Area, combing with runoff from the 72-inch North Wenatchee Avenue outfall for City of Wenatchee Basin M-5000. This basin includes a portion of the Apple Capital Recreation Loop Trail that runs parallel to and east of the BNSF railroad tracks.
- **Basin E** consists of approximately 15 acres of the project area that drain to the Wenatchee and Columbia rivers through Confluence State Park and at the proposed Wenatchee River crossing. This basin contains natural, vegetated areas adjacent to the Wenatchee River, paved areas adjacent to the McDougall & Sons facility and the access road to Confluence State Park.
- **Basin F** consists of approximately 10 acres of the project area in the Olds Station area of Wenatchee that drain to the Columbia River via a 24-inch outfall east of Euclid Avenue. The basin includes portions of Isenhart Avenue and Euclid Avenue, both of which are developed urban streets with curbs, gutters and catch basins.
- **Basin G** consists of approximately 1 acre of the project area in Olds Station area of Wenatchee that drains to the Olds Station Regional Stormwater Facility and ultimately outfalls to the Wenatchee River via a 72-inch pipe.

2.2 Offsite Analysis

Following is a qualitative discussion of upstream and downstream conditions for each of the project drainage basins described in Section 2.1 and shown on Figure 2. Upstream areas are shown on Figure 3.

Basin A

Runoff from Basin A is collected by a 48-inch storm drain beneath N Miller Street south of Maple Street. This storm drain conveys runoff from City of Wenatchee Basin M-700, which consists of approximately 2,000 acres of upstream area.

Record drawings and City of Wenatchee GIS indicate the drainage system in Basin A begins as a 48-inch pipe that runs northeast at a slope of 0.5%. Approximately 700 feet north of Walla Walla Avenue, the drainage system consists of a 60-inch pipe that runs northeast for approximately 600 feet with 2-3% slope. At the Apple Capital Recreation Loop Trail, this drainage system turns to the east and continues another 390 feet as a 48-inch pipe with 2.4% slope. The drainage system then turns northeast and continues as a 48-inch pipe at 21% slope to a submerged outfall to the Columbia River (Walla Walla Outfall).

The March 2010 City of Wenatchee Comprehensive Stormwater Plan Update included hydraulic modeling of the 48-inch N Miller Street storm drain and concluded that the downstream 1,000 feet of the conveyance system to the outfall has adequate capacity for existing and future conditions. However, 1,600 feet of the existing 48-inch drainage system along N Miller Street south to Maple Street requires replacement with 72-inch pipe. This improvement is identified as Project C1 - North Miller Drainage Improvements in the Comprehensive Stormwater Plan; however, subsequent investigations by the City indicate that a 60-inch pipe will suffice.

Basin B

Runoff from Basin B is collected by a 12-inch storm drain on the east side of North Wenatchee Avenue and along N Miller Street north of Maple Street. Based on City of Wenatchee GIS, this drainage system flows south along the east side of N Wenatchee Ave from Maple Street for 4,800 feet to 5th Avenue, where it discharges into a 48-inch concrete storm sewer that flows northeast under 5th Street to an outfall to the Columbia River located 200 feet south of 5th Street.

Basin C

Runoff from Basin C is collected by the Number 1 Canyon Drain, a 36-inch corrugated metal storm drain that conveys runoff from a 4,000-acre area west of Wenatchee through the city to an outfall within the Horan Natural Area. Catch basins along a portion of Hawley Street are connected to the 36-inch storm drain, which conveys flows northeast beneath the Chelan County PUD substation and maintenance facility. Based on mapping included in the 2018 Chelan County PUD Stormwater Management Program Plan, this pipe is corrugated metal and extends for 400 feet northeast of Hawley Street to a manhole at the back of the maintenance yard, then turns northwest and continues another 120 feet to an outfall to a ditch located on private property (No. 1 Canyon Drain Outfall). The ditch continues for approximately 400 feet on private property before reaching the Horan Natural Area boundary, then another 1,100 feet to a 60-inch diameter corrugated metal culvert conveying the ditch under a trail an into a constructed pond.

Basin D

Runoff from the southern portion of Basin D flows north along the Apple Capital Recreation Loop Trail north from Hawley Street for approximately 750 feet to an existing 66-inch storm culvert that discharges to the east into the Horan Natural Area (Hawley Street Outfall). This storm drain conveys runoff from City of Wenatchee Basin M-5000, which consists of approximately 990 acres of upstream area, and a portion of runoff from 240-acre Basin M-6000. An upstream flow splitter divides storm flows from Basin M-6000 between the 66-inch Hawley Street outfall and the North Wenatchee outfall near the Wenatchee River. North of the 66-inch culvert under the Apple Capital Recreation Loop Trail, runoff within Basin D appears to drain to the east into the Horan Natural Area, primarily as unconcentrated, dispersed flows.

Existing drainage patterns within the Horan Natural Area (Basins C and D) are not well defined due to flat topography, wetlands, and flooded conditions during periods of high flow in the Columbia and Wenatchee rivers. Stormwater from the No. 1 Canyon Drain outfall discharges into an open channel that leads towards the east (downstream) end of a series of constructed ponds. Stormwater from the 66-inch Hawley Street outfall generally flows north into wetlands adjacent to the west (upstream) end of the constructed pond system.

The ponds are connected at three trail crossings by 60-inch culverts. A 36-inch culvert connects the ponds to the Columbia River; however it has been reported that water from the ponds does

not typically flow into the Columbia River. However, river water has been observed to back up into the ponds during periods of high water.

Figure 1 – Vicinity Map

N MILLER ST
MAPLE ST
NO. 1 CANYON DRAIN
WALNUT ST
MAIDEN LN
HORSE LAKE RD
EXIST SD NETWORK (TYP)
STREAMS AND WATERBODIES (GIS, TYP)
BNSF RAILROAD
12" SD
BNSF RAILROAD
N WENATCHEE AVE
McKITTRICK ST
HAWLEY ST
42" SD
36" SD
36" SD
DITCH
CHATHAM HILL DR
CONFLUENCE PARKWAY
60" SD
PROP OUTFALL
CORDELL AVE
36" SD
48" SD
WALLA WALLA AVE
EXIST REGIONAL POND OUTFALL
N WENATCHEE AVE
EXIST HAWLEY ST OUTFALL
OLDS STATION REGIONAL STORMWATER FACILITY
60" SD
HORAN NATURAL AREA
OLDS STATION RD
TECHNOLOGY CENTER WAY
HORAN AVE
48" SD
EXIST NO. 1 CANYON DRAIN OUTFALL
WENATCHEE RIVER
WALLA WALLA POINT PARK
APPROX. WETLAND LOCATION (GIS, TYP)
BNSF RAILROAD
PENNY ROAD
EXIST WALLA WALLA AVE OUTFALL
WENATCHEE CONFLUENCE STATE PARK
DITCH
ISENHART AVE
COLUMBIA RIVER
15" SD
EUCLID AVE
EXIST STATE PARK OUTFALL
OPEN CHANNEL
24" SD
EXIST COLUMBIA OUTFALL
24" SD

NOTE: FIELD SURVEYS AND RIGHT-OF-WAY CENTERLINES / MARGINS SHOWN ARE NOT NECESSARILY COMPLETE OR ACCURATE AND ARE BASED UPON A COMBINATION OF BEST AVAILABLE GIS DATA AND PARTIAL SURVEY INFORMATION.

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City of Wenatchee

BASIN A | BASIN B | BASIN C | BASIN D | BASIN E | BASIN F | BASIN G

EXIST SD PIPE

DOWNSTREAM FLOW PATH

FIGURE 2. PROJECT AREA DRAINAGE BASIN MAP

CONFLUENCE PARKWAY SR 285 BYPASS

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NUMBER TWO CANYON DRAINAGE BASIN

NUMBER ONE CANYON DRAINAGE BASIN

BASIN M-700 TO WALLA WALLA AVE OUTFALL

BASIN M-5000 TO HAWLEY ST OUTFALL

BASIN M-6000

OLDS STATION REGIONAL FACILITY OUTFALL

OLDS STATION D BASIN

BASIN F UPSTREAM BASIN

EXIST HAWLEY ST OUTFALL

EXIST NO. 1 CYN. OUTFALL

EXIST WALLA WALLA AVE OUTFALL (INCL. NO. 2 CYN. PRIMARY FLOWS)

EXIST NO. 2 CYN. OUTFALL (OVERFLOWS ONLY)

EXIST COLUMBIA OUTFALL

BACKGROUND MAP: USGS US TOPO

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City of Wenatchee

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PROJECT AREA

UPSTREAM AREA

FIGURE 3. UPSTREAM DRAINAGE BASIN MAP

CONFLUENCE PARKWAY SR 285 BYPASS

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Stormwater from the two outfalls into the Horan Natural Area has been reported to not reach the existing ponds, resulting in stagnant conditions (from North Central Washington Audubon Society website). There is a desire to reintroduce stormwater runoff to the ponds and create new wetlands. This concern is being addressed in part by a current City project, the North Wenatchee Avenue Stormwater Improvements, that will direct all runoff from 240-acre drainage Basin M-6000 to the Horan Natural Area via the 72-inch outfall, removing a flow splitter that currently directs a portion of stormwater runoff to the Wenatchee River. In addition, the Chelan County PUD is undertaking studies of the wetlands and ponds within the Horan Natural Area, including water level monitoring that will be used to interpret correlations between hydropower operations and Columbia River flows with water levels in the ponds.

Basin E

The southern portion of Basin E consists of the future Wenatchee River crossing and vegetated areas of Wenatchee Confluence State Park where runoff flows south to the river. The remainder of Basin E consists of areas that appear to have dispersed runoff into the developed areas of the park, where runoff is collected in a ditch and culvert system that flows east along the north side of main access road. Based on mapping contained in the 2018 Chelan County PUD Stormwater Management Program Plan, a 500-foot long, 15-inch PVC storm drain pipe at a 0.4% slope drains the ditch to the Columbia River in the northeast corner of the park (Wenatchee Confluence State Park Outfall).

Although Basin E includes discharges to both the Wenatchee and Columbia rivers, it has been delineated as a single drainage basin for this study in anticipation that this section of Confluence Parkway will utilize a single stormwater management facility that either infiltrates, if feasible, or discharges to the Wenatchee River.

The existing Olds Station Regional Stormwater Facility is located west of Basin E, on the opposite side of the McDougall & Sons facility and BNSF railroad tracks from the proposed Confluence Parkway alignment. Based on information contained in the 2012 Chelan County Comprehensive Stormwater Plan, this regional stormwater facility (infiltration pond/stilling basin) was constructed around 1999 and serves an approximate basin area of 200 acres in the Olds Station and Sunnyslope areas, including the Highway 2 / N Wenatchee Avenue interchange. The stormwater facility outfall to the Wenatchee River could provide an opportunity for a combined outfall for this basin that would avoid creating a new outfall to the Wenatchee River.

Basin F

Runoff from Basin F is collected by existing 12-inch to 18-inch storm drains along Isenhart Avenue and Euclid Avenue, which would be reconstructed as Confluence Parkway. Based on City of Wenatchee GIS information, the existing storm drain along Isenhart Avenue flows south to Olds Station Road, then turns east and continues along Olds Station Road in an 18-inch pipe at a 0.7% slope for 800 feet to Euclid Avenue, then north along Euclid Avenue in a 12-inch pipe at 0.1% slope for 450 feet. At this point the drainage system turns east and continues for 1,000 feet in a 24-inch pipe at 3% slope that discharges to an open swale that flows south parallel to the west side of the Apple Capital Recreation Loop Trail. A 24-inch pipe at a 15% slope discharges runoff in the swale to the Columbia River (Columbia Outfall).

Runoff from the northern portion of Basin F flows south along Euclid Avenue in 12-inch and 18-inch pipes to the 24-inch storm drain that flows east to the Columbia River Outfall.

Basin F has approximately 60 acres of upstream tributary area located between Isenhart Avenue and the BNSF railroad tracks and west of Euclid Avenue north of Penny Road. Flooding has been reported upstream of the project area in the vicinity of Penny Road.

A conveyance capacity analysis for this basin will be performed as part of final design to verify adequate capacity in this drainage system, particularly the 12-inch pipe with a 0.1% slope along Euclid Avenue that appears undersized compared to other components of this drainage system, and to determine the cause of upstream flooding in the vicinity of Penny Road.

Basin G

Runoff in Basin G from Olds Station Road is collected by catch basins and travels east-southeast for 120 feet in a 48-inch diameter pipe. Runoff then heads southwest along the western side of the existing BSNF railroad in a 72-inch diameter pipe for 252 feet. Non-diverted runoff enters the existing Old Station Regional stormwater facility before reentering the 72-inch diameter pipe and travels southwest for 141 feet before discharging into the Wenatchee River.

Basin G has approximately 200 acres of upstream tributary area located northwest of the project site in the Olds Station and Sunnyslope areas. Conveyance and capacity analysis will be performed as part of the final design for the existing storm drainage system and the Old Station regional stormwater facility.

2.3 Soil Conditions

At this time, subsurface exploration focused on the feasibility of stormwater infiltration within the project area has not been performed. However, infiltration measurements performed near the project site at McKittrick Street found the underlying soil to be slow draining and unsuitable for infiltration, and additional geotechnical survey would need to be performed at areas of interest throughout the site to determine suitability.

Several previous geotechnical studies have been undertaken within the vicinity of the project that provide information regarding subsurface conditions. These previous studies include:

- *Report of Geotechnical Exploration, Proposed Confluence Parks*, prepared by Converse Consultants NW, June 10, 1988
- *Subsurface Investigation Letter Report, Northwest Wholesale, Inc., 1467 North Wenatchee Avenue,* prepared by Environmental Partners Inc., June 16, 2016
- *Draft Geotechnical Report Permitting and Preliminary Engineering, Wenatchee River Crossing SR 285/North Wenatchee Avenue Bypass*, GeoEngineers, April 26, 2019
- *Draft Geotechnical Report Permitting and Preliminary Engineering, McKittrick Street BNSF Underpass, SR 285/North Wenatchee Avenue Bypass*, prepared by GeoEngineers, April 26, 2019.

Based on review of these reports, it appears the majority of the Confluence Parkway alignment is located on alluvial terraces underlain by a thick layer of sands, silts, and clays, above a layer of courser sands, gravels, and cobbles. Subsurface explorations performed in the vicinity of Hawley and Miller Streets indicate the sand and silt layer is approximately 40 feet thick and includes clay layers. Subsurface exploration performed for Wenatchee Confluence State Park indicates the lower terrace both north and south of the Wenatchee River is underlain by silt and sand approximately 10-12 feet thick.

The USDA Web Soil Survey was also reviewed. Mapped soils consist primarily of Cashmere sandy loam and Cashmont sandy loam, which are classified as Hydrologic Group A (well drained) soils. Smaller areas of Burch loam, Burch fine sandy loam, Quincy loamy fine sand and Terrace escarpments exist with the project area (see USDA Soil Map, Appendix B).

Due to the presence of silty materials near the surface and reports of low infiltration rates near the site, it appears unlikely that infiltration will be relied upon as the primary method of stormwater management of this project. However, additional site specific evaluation will be needed to confirm this conclusion and to determine if shallow facilities such as bio-infiltration swales could be feasible in some areas of the project.

3. Analysis of Stormwater Management Requirements

WCC 9.20 requires projects disturbing an area greater than or equal to one acre to comply with the requirements of the SWMMEW and additional local requirements.

Following is a preliminary analysis of how the eight Core Elements of the SWMMEW will apply to this project. Although all Core Elements have been analyzed, the focus of this preliminary design report is Core Element 5 – Runoff Treatment and Core Element 6 – Flow Control, because they have the potential to require constructed stormwater facilities. Full documentation of all Core Elements will be included in the Stormwater Site Plan report to be completed as a part of the final design of the project.

3.1 Applicability of the Core Elements

Application of Core Elements of the SWMMEW is dependent on the area of land disturbance and areas of new and replaced impervious surfaces resulting from the project. Preliminary values for the Confluence Parkway project are as follows:

Table 1 – Preliminary Project Area Summary

	Basin A	Basin B	Basin C	Basin D	Basin E	Basin F	Basin G	Total
Area of Land Disturbance	6.69 ac	6.52 ac	2.01 ac	9.06 ac	6.20 ac	8.88 ac	1.01 ac	40.36 ac
Existing Impervious	4.36 ac	5.43 ac	0.69 ac	1.12 ac	0.87 ac	6.09 ac	0.60 ac	19.16 ac
% Exst. Impervious	65%	83%	34%	12%	14%	69%	60%	47%
New NPGIS[2]	0.30 ac	0.10 ac	0.35 ac	0.74 ac	0.22 ac	0.80 ac	0.05 ac	2.57 ac
Replaced NPGIS	0.81 ac	0.78 ac	0.19 ac	0.10 ac	0.00 ac	0.47 ac	0.05 ac	2.39 ac
New PGIS[3]	0.42 ac	0.67 ac	0.11 ac	2.54 ac	1.97 ac	0.94 ac	0.12 ac	6.77 ac
Replaced PGIS	3.10 ac	2.97 ac	0.03 ac	0.00 ac	0.00 ac	4.43 ac	0.33 ac	10.85 ac
Total New + Repl. PGIS & NPGIS	4.63 ac	4.52 ac	0.68 ac	3.37 ac	2.19 ac	6.65 ac	0.55 ac	22.59 ac
Total New PGIS & NPGIS	0.72 ac	0.77 ac	0.46 ac	3.27 ac	2.19 ac	1.75 ac	0.17 ac	9.34 ac
Total New PGIS & NPGIS	3.52 ac	3.64 ac	0.14 ac	2.54 ac	1.97 ac	5.37 ac	0.45 ac	17.63 ac
Treatment Required?[4]	YES	YES	YES	YES	YES	YES	YES	
Flow Control Required?[5]	NO	NO	YES	YES	NO	MAYBE	MAYBE	

Notes:

1. Site Area = Full right-of-way width for length of project
2. NPGIS = Non-pollution generating impervious surface.
3. PGIS = Pollution-generating impervious surface.
4. See Section 3.2, Core Element 5 for discussion of treatment requirements.
5. See Section 3.2, Core Element 6 for discussion of flow control requirements.

Since the project already contains a significant area of impervious surface, the project meets the definition of redevelopment in the SWMMEW. Based on the flowchart on Figure 2.2: Flow Chart for Determining Applicable Core Elements for Redevelopment Projects of the SWMMEW (see Appendix A), the project will be subject to the requirements of:

- Core Elements 2 and 3 for the entire site
- Core Elements 1 – 4 and 8 for the new and replaced impervious areas
- Core Elements 5 and 7 for the new and replaced PGIS areas
- Core Elements 6 and 7 for the new PGIS and NPGIS areas

3.2 Analysis of the Core Elements

The following describes how the project will satisfy each of the applicable Core Elements:

Core Element 1 – Preparation of a Stormwater Site Plan

Preparation of a complete stormwater site plan, including drainage report, will be completed as part of the final design of this project.

Core Element 2 – Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (SWPPP) will be prepared for this project prior to construction, either by the City or by the contractor as a requirement of the construction contract.

Core Element 3 – Source Control of Pollution

The only source control BMPs that would be applicable to this project are those associated with a construction site. Construction source control BMPs will be addressed in the SWPPP as part of Core Element 2.

Core Element 4 – Preservation of Natural Drainage Systems

This Core Element requires that projects maintain natural drainage patterns and locate discharges from the project site at the natural location to the maximum extent practicable. Since much of the project site is within previously-developed areas, few natural drainage systems still exist. This is the case for Basins A, B, F, and G as well as a portion of Basin E, which drain into constructed drainage systems that discharge to the Wenatchee and Columbia rivers.

Wetlands and ponds do exist in the Horan Natural Area, and although they appear to have been previously constructed, they could be considered natural systems that require preservation. The Wenatchee River at the proposed bridge crossing would also meet the definition of a natural drainage system.

Runoff from Basin C could be discharged into the No. 1 Canyon Drain consistent with current conditions, thereby maintaining runoff to the Horan Natural Area. However, runoff from this basin could also be combined with an outfall for Basin D, or another location within the Horan Natural Area. The location and method of this discharge will be developed during final design with the input of Chelan County PUD, which is seeking to improve conditions in downstream wetlands and ponds.

Runoff from Basin D, which in the existing condition discharges from the site primarily via sheet flow into the Horan Natural Area, could have a concentrated discharge point as a result of the need to construct flow control and runoff treatment facilities. As with Basin C, the location and method of this discharge will be developed during final design with the input of Chelan County PUD, which is seeking to improve conditions in downstream wetlands and ponds.

Runoff from Basin E, which currently disperses into the developed portion of Wenatchee Confluence State Park north of the Wenatchee River, will most likely discharge from runoff treatment facilities to the Wenatchee River, unless infiltration is found to be feasible.

Core Element 5 – Runoff Treatment

Runoff treatment is required for this projects because more than 5,000 square feet (0.115 acre) of new and replaced pollution-generating impervious surface (PGIS) will be created. At a minimum, basic treatment, which has a goal of removing 80% of total suspended solids, is required for runoff from PGIS that will be directed to surface waters. Metals treatment, which is intended to provide a higher rate of removal of dissolved metals than basic treatment, is required for this project because it consists of urban roads that have an expected average daily traffic (ADT) volume of more than 7,500. However, areas of the project that discharge directly to the Columbia River or Wenatchee River are eligible for a metals treatment exemption as

described in Section 2.7.6 (page 87) of the 2019 SWMMEW. The metals treatment exemption would most likely apply to Basins A, B, E, F and G; therefore runoff treatment facilities in these basins would only be required to provide basic treatment.

Oil control treatment is required for high-ADT roadways (greater than 30,000 vehicles per day) and intersections with more than 25,000 ADT on the main roadway and greater than 15,000 ADT on the intersecting roadways. It appears the Confluence Parkway corridor will not trigger oil-control requirements because Confluence Parkway is expected to have an ADT of 14,600 vehicles, less than the 30,000 threshold; however, the reconfigured intersection of North Miller Street and North Wenatchee Avenue may exceed the ADT thresholds and require oil treatment, because North Wenatchee Avenue is forecasted to have an ADT of 34,300 vehicles following construction of Confluence Parkway.

Projects that manage stormwater runoff using subsurface infiltration are not subject to the runoff treatment requirements of Core Element #5; however infiltration facilities that are classified as underground injection control (UIC) wells require treatment by the vadose zone or by structural BMPs. Section 5.6.16 of the SWMMEW provides guidance on treatment requirements for infiltration.

Based on these requirements it appears that basic runoff treatment will be required for all pollution-generating surfaces within the project area unless subsurface infiltration is used and adequate treatment will be provided by the vadose zone. Metals treatment will be needed for discharges within the Horan Natural Area and oil water separation may be needed for the North Wenatchee / North Miller Street intersection.

Core Element 6 – Flow Control

Flow control is required for projects that add 10,000 square feet (0.23 acre) or more of new impervious surface. Discharges to the Columbia River and Wenatchee River are exempt from flow control requirements.

Although Basin A will create more than 10,000 square feet (0.23 acre) of new impervious surface, it is expected that flow control will not be required because a pipe capacity analysis included in the 2010 City of Wenatchee Comprehensive Stormwater Plan Update indicates that the N Miller Street outfall has sufficient capacity to convey future condition runoff. In addition, Wenatchee City Code 9.20.040 states that redevelopment projects are not required to construct flow control facilities. However, it may be necessary to increase the size of a portion of the 48-inch storm drain beneath N Miller Street to 72-inch pipe (Project C-1 in the 2010 Comprehensive Stormwater Plan Update) or 60-inch per more recent City investigations.

Basin B will not require flow control because less than 10,000 square feet (0.23 acre) of new impervious surface will be added, and because the downstream drainage system discharges directly to the Columbia River.

Basins C and D may require flow control because these basins will depend on potential future hydraulic modifications needed within the Horan Natural Area to support pond and wetland improvements. Core Element #6 states that discharges to wetlands do not need to meet the

Ecology flow control requirements for protecting stream morphology; however, flow control may still be required to protect the wetlands.

Per the SWMMEW, stormwater detention facilities must be sized to either retain runoff from the 2-year design storm on site or discharge at 50% of the predevelopment 2-year rate. Runoff from the 25-year design storm must be discharged at the 25-year predevelopment release rate. If this requirement is determined to be appropriate to protect wetlands downstream of Basins C and D, it appears an approximate detention volume of 24,100 cubic feet would be required for the estimated 3.74 acres of new impervious surface, assuming existing impervious surfaces (primarily the Apple Capital Recreation Loop Trail) do not require mitigation.

Basin E will not require flow control if project area runoff discharges directly to the Wenatchee River via an existing outfall.

Whether or not flow control is required for Basin F will depend on the capacity of the existing 12-inch and 18-inch conveyance systems along Olds Station Road, Euclid Avenue, and the 24-inch drainage system extending east from Euclid Avenue to the Columbia River. If flow control is required for Basin F, an approximate detention volume of 11,300 cubic feet would be required for the estimated 1.75 acres of new impervious surface.

Basin G may not require flow control because the new impervious area is less than 10,000 square feet. However, the Olds Station Regional Stormwater Facility is located downstream of the basin and will receive runoff from the project area, which will come from Olds Station Road and the new pedestrian path. The regional facility needs to be checked to ensure that there is sufficient capacity for the additional runoff from the site. If the existing regional facility does not have capacity for the additional flow, the facility will need to be retrofitted or an additional detention facility would be required. Approximately 2,450 cubic feet would be required for the estimated 0.17 acres of impervious surface.

Core Element 7 – Operation and Maintenance

The stormwater facilities to be constructed for this project will be operated and maintained by the City of Wenatchee. As a result, no maintenance agreements are required. However an Operation and Maintenance Manual will be prepared during final design and included in the Stormwater Site Plan report if the proposed stormwater design includes facility types that are not already maintained by the City.

Core Element 8 – Local Requirements

Per Wenatchee City Code 9.20.050(1), new development and redevelopment projects must retain stormwater runoff generated onsite for 10-year, 24-hour rainfall unless it meets exemption criteria outlined in the SWMMEW. Potential exemptions to this requirement include the following:

- Soils that do not allow infiltration of the required volume of stormwater runoff
- Proximity to a known hazardous waste site or landfill
- Proximity to a drinking water well or spring

- Proximity to an onsite sewage system or underground storage tank
- Setbacks to structures
- Landslide hazard areas or slopes
- Seasonal high groundwater
- Incompatibility with the surrounding drainage system
- Areas prone to erosion

Based on preliminary geotechnical investigation of the site, Confluence Parkway may be exempt due to inadequate infiltration capacity of the underlying soil. More detailed soil investigations will be required for future design.

4. Stormwater Management Alternatives

Based on the findings of the previous section, the following additional information will be needed to fully develop an appropriate stormwater management approach for this project:

1. Infiltration potential throughout the project corridor, including treatment capacity within the vadose zone.
2. Stormwater flow rates and volumes needed for enhancement of the Horan Natural Area, including any upstream detention or treatment that would be required.
3. Feasibility of incorporating LID approaches such as bioretention and permeable pavement into the roadway design.
4. Feasibility of discharging runoff at the existing 66-inch Hawley Street outfall versus creating a new, adjacent outfall.

However, in the absence of this additional information, the following concepts for flow control and water quality treatment have been developed as a first step towards identifying the type and size of stormwater facilities that could be required. These concepts are shown on Figures 4A and 4B.

4.1 Flow Control Alternatives

As discussed in Section 3.2 for Core Element 6, flow control is required for new impervious surfaces within segments of the project area that do not discharge runoff directly to the Columbia River or Wenatchee River. Because Basins A, B and E will discharge directly to the Columbia River and Wenatchee River, flow control is not required for these basins. Therefore, this section focuses on flow control for Basins C, D, F, and G.

Basins C and D

Flow control is required for Basin C and Basin D, as both discharge into Horan Natural Area before reaching the Wenatchee and Columbia rivers. Flow control will be provided by a detention pond, which has been sized based on the SCS/SBUH method per the SWMMEW and City of Wenatchee guidance. The proposed detention pond would need to have a storage volume of approximately 24,100 cubic feet, based on a combined 3.74 acres of new impervious surfaces (both PGIS and NPGIS) in Basins C and D, Hydrologic Group A, Cashmont series soils,

and grass/pasture existing land cover (see Appendix C for preliminary sizing calculations). Two alternatives have been explored for placement and geometry of the detention pond. For Option 1, the detention pond would be placed adjacent to the 66-inch Hawley Street outfall. In Option 2, the detention pond would be linear and parallel to Confluence Parkway, situated between the roadway and the relocated Apple Capital Recreation Loop Trail.

Basins F

Flow control may be required for Basin F due to existing flooding upstream of the Columbia outfall. If flow control is required, approximately 11,600 cubic feet of storage would be needed based on 1.75 acres of new impervious surface, Hydrologic Group A, Cashmere series soils and grass/pasture existing land cover (see Appendix C for preliminary sizing calculations). It is anticipated that an infiltration facility, if feasible, would require a similar storage volume. However, prior to final design of either an infiltration or detention facility, additional analysis of the existing downstream drainage system will need to be performed to determine the extent and frequency of the flooding and potential capacity improvements. Another option would be to divert runoff from a portion of the project area within Basin F to Basin E, for treatment and discharge to the Wenatchee River.

Basins G

Flow control may be required for Basin G if the existing Old Station Regional Facility does not have adequate capacity for new impervious surface resulting from the project. If flow control is required, approximately 2,450 cubic feet of storage would be needed based on 0.17 acres of new impervious surface, Hydrologic Group A, Cashmere series soils and grass/pasture existing land cover (see Appendix C for preliminary sizing calculations). It is anticipated that an infiltration facility, if feasible, would require a similar storage volume. However, prior to final design of either an infiltration or detention facility, additional analysis of the existing downstream drainage system will need to be performed to determine the extent and frequency of the flooding and potential capacity improvements. Another option would be to divert runoff from a portion of the project area within Basin G to Basin E to bypass the existing stormwater facility, for treatment and discharge to the Wenatchee River.

4.2 Water Quality Treatment Alternatives

As discussed in Section 3.2 for Core Element 5, water quality treatment is required for both new and replaced pollution-generating impervious surfaces (PGIS) within the project areas. Basic treatment, which has a goal of 80% removal of total suspended solids (TSS), is required for segments of the project that discharge runoff to the Columbia River or Wenatchee River. The following options currently exist for basic treatment:

- Bioinfiltration swale
- Biofiltration swale
- Bioretention
- Vegetated filter strip

- Wetpond or wetvault
- Combined detention/wetpond
- Sand filter
- Emerging technologies with a General Use Level Designation (GULD) for basic treatment from Ecology's TAPE program (including proprietary media filters such as Modular Wetland, Filterra, BioPod, StormFilter, Bay Filter) or WSDOT Media Filter Drain.

Metals treatment, which in addition to the 80% removal of TSS, also has a goal of removing more than 30% of dissolved copper and 60% of dissolved zinc, is required for all other areas of the project that do not discharge runoff to the Columbia or Wenatchee rivers. The following options currently exist for metals treatment:

- Bioinfiltration swale
- Bioretention
- Infiltration pond or trench
- Treatment train with sand filter
- Emerging technologies with a General Use Level Designation (GULD) for enhanced treatment from Ecology's TAPE program (including proprietary media filters such as Modular Wetland, Filterra, BioPod) or WSDOT Media Filter Drain or Compost-Amended Biofiltration Swale

Oil control treatment has a goal of no ongoing or recurring visible sheen and a 24-hour average total petroleum hydrocarbon (TPH) concentration of < 10 mg/L and a maximum of 15 mg/L for a discrete sample. Oil control is required for high use intersections where the average daily traffic volume (ADT) exceeds 25,000 on the main roadway and 15,000 on the intersecting roadway, which may apply to reconstruction of the N Wenatchee Avenue / N Miller Street intersection. The following options currently exist for oil control treatment:

- American Petroleum Institute (API) or coalescing plate separator
- Linear sand filter
- Compost amended vegetated filter strip
- Bioinfiltration swale
- Bioretention
- Emerging technologies with a General Use Level Designation (GULD) for Oil Control from Ecology's TAPE program (including Filterra or WSDOT Compost-Amended Biofiltration Swale)

Basins A and B

Basins A and B discharge directly into the Columbia River. Therefore, basic water quality treatment is required for this portion of the project. As discussed above, there are several options for basic treatment. One option could be to use proprietary media filter units at catch basin locations to collect and treat surface runoff from the roadway before discharging into the existing storm drainage system. Proprietary media filters typically require less space than the other options and would not require a separate storm drainage collection system, both of which are advantages for retrofitting an existing roadway. The maintenance costs of proprietary media

filters can be greater than other options, however, so an analysis of all treatment options will need to be performed during final design before a treatment approach is selected.

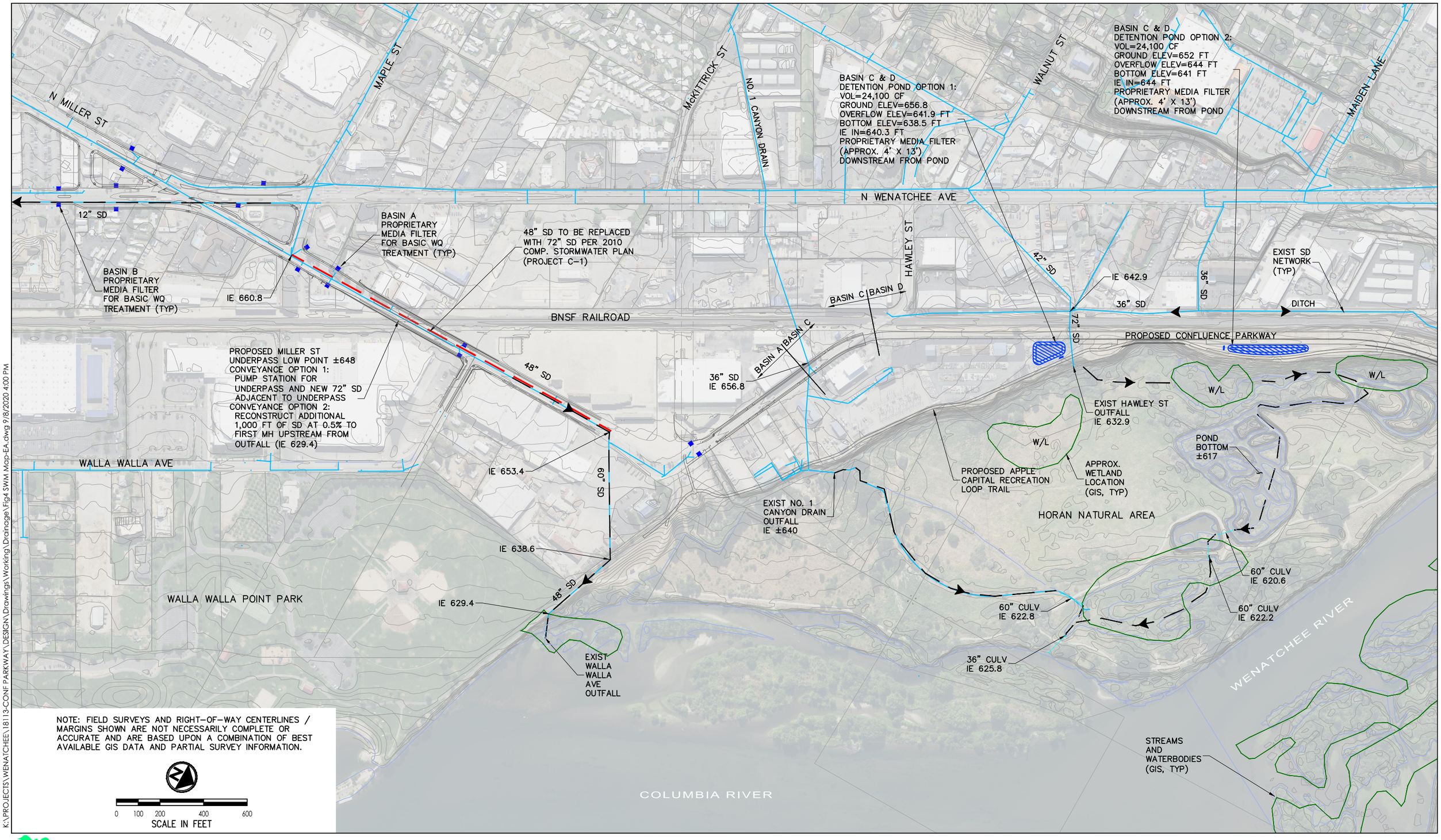
If oil control is required at the N Wenatchee Avenue / N Miller Street intersection due to exceeding vehicle volume thresholds, Filterra units could provide both basic treatment and oil control in this area, or separate coalescing plate oil/water separators could be used. If open space is available in the intersection area, bioretention could also provide both basic and oil control treatment.

Basins C and D

For Basins C and D, metals treatment is required. As discussed above, there are several options for metals treatment. If a detention pond is included in the final design to comply with Core Element #6, one option for metals treatment could be to install a proprietary media filter unit downstream of the detention pond. The proprietary unit (Biopod, Filterra, Modular Wetland System, et al.) would be sized for the 2-year Q_{peak} discharge from the detention pond flow restrictor. Since the detention pond will result in decreased runoff rates, installing the treatment facility downstream of the pond could result in a smaller, less costly treatment facility than if it were constructed upstream of the detention pond. Other non-proprietary treatment options such as bioretention could also be considered during final design.

Basins E, F, and G

Basins E, F, and G discharge directly into the Wenatchee and Columbia rivers. Basic water quality treatment is required for new and replaced PGIS in this portion of the project. Basic water quality treatment can be provided for Basin E by a wet pond with a volume of 6,900 cubic feet or by constructing a bioinfiltration swale along the west side of Confluence Parkway. Water quality treatment for the northern portion of Basin F, which contains existing roadways and storm drainage systems, could be achieved by installing proprietary water quality treatment units at catch basins as discussed for Basins A and B. Runoff treatment for the southern portion of Basin F could also be achieved by either constructing a 18,650 cubic-foot wet pond at the intersection of Olds Station Road and the proposed Confluence Parkway, or by installing a proprietary media filter at this location. Basic water quality treatment can be provided for Basin G by a wet pond with a volume of 1,600 cubic-feet or bioinfiltration swale adjacent to Olds Station Road.



NOTE: FIELD SURVEYS AND RIGHT-OF-WAY CENTERLINES / MARGINS SHOWN ARE NOT NECESSARILY COMPLETE OR ACCURATE AND ARE BASED UPON A COMBINATION OF BEST AVAILABLE GIS DATA AND PARTIAL SURVEY INFORMATION.

K:\PROJECTS\WENATCHEE\18113-CONF PARKWAY\DESIGN\Drawings\Working\Drainage\Fig4 SWM Mcp-EA.dwg 9/8/2020 4:00 PM

City of Wenatchee

EXIST SD PIPE

DOWNSTREAM FLOW PATH/ OPEN CHANNEL

REPLACED SD PIPE

FIGURE 4A. PROJECT AREA DRAINAGE CONCEPTS, BASINS A - D

CONFLUENCE PARKWAY SR 285 BYPASS

KPG
Interdisciplinary Design
23 South Wenatchee Avenue, Suite 223
Wenatchee, WA 98801
(509) 663-2711 | www.kpg.com

BASIN G FLOW CONTROL NOTE:
ONE OF THE FOLLOWING OPTIONS MAY NEED TO BE IMPLEMENTED DEPENDING ON THE CAPACITY OF THE EXISTING REGIONAL STORMWATER FACILITY FOR ADDITIONAL RUNOFF FROM 0.17 AC OF NEW IMPERVIOUS SURFACE:
OPT 1 – DETENTION FACILITY (APPROX. 2,4500 CF)
OPT 2 – INFILTRATION FACILITY
OPT 3 – DIVERSION OF RUNOFF FROM 0.17 AC TO BASIN E WENATCHEE RIVER OUTFALL VIA NEW SD NETWORK CONNECTION

CORDELL AVE
EASY ST
CHESTER KIMM RD
PENNY RD
TECHNOLOGY CENTER WAY
N WENATCHEE AVE
HORAN RD
OLDS STATION RD

BASIN G OUTFALL, UPSTREAM OF EXISTING STORMWATER FACILITY

BASIN E OUTFALL DISCHARGE DOWNSTREAM OF OLDS STATION POND OUTLET SPILLWAY

OLDS STATION REGIONAL STORMWATER FACILITY

BASIN F – NORTH PROPRIETARY WQ TREATMENT, BASIC (TYP)

BASIN F

BASIN F – SOUTH
WQ OPTION 1:
WET POND
VOLUME=18,650 CF
GROUND ELEV = 670
WS ELEV= 664 FT
BOTTOM ELEV= 659 FT
IE IN = 664.5
WQ OPTION 2:
PROPRIETARY MEDIA FILTER
(54 FT X 10 FT BIOPOD OR EQUIVALENT)

BASIN E WQ OPTION 1:
BIOINFILTRATION SWALE
1,400 FT X 5 FT X 1 FT

BASIN E | BASIN F

BNSF RAILROAD

EXIST 12" SD @ 0.9%

IE 665.89

EXIST 18" SD @ 0.5%

BASIN F FLOW CONTROL NOTE:
ONE OF THE FOLLOWING OPTIONS MAY NEED TO BE IMPLEMENTED DEPENDING ON THE CAPACITY OF THE EXISTING DOWNSTREAM CONVEYANCE SYSTEM FOR ADDITIONAL RUNOFF FROM 1.4 AC OF NEW IMPERVIOUS SURFACE:
OPT 1 – DETENTION FACILITY (APPROX. 11,300 CF)
OPT 2 – INFILTRATION FACILITY
OPT 3 – CONVEYANCE UPGRADES
OPT 4 – DIVERSION OF RUNOFF FROM 1.4 AC TO BASIN E WENATCHEE RIVER OUTFALL

EUCLID AVE

EXIST 18" SD @ 0.7%

EXIST 12" SD @ 0.1%

EXIST 24" SD @ 3%

BASIN D | BASIN E

BASIN E WQ OPTION 2:
WET POND
VOLUME=6,900 CF
GROUND ELEV = 639 FT
WS ELEV= 638 FT
BOTTOM ELEV= 636 FT
IE IN = 640 FT

DITCH

EXIST 24" SD @ 15%

OPEN CHANNEL

EXIST COLUMBIA OUTFALL

W/L BOUNDARY (GIS, TYP)

WENATCHEE CONFLUENCE STATE PARK

15" SD

EXIST STATE PARK OUTFALL

WENATCHEE RIVER

COLUMBIA RIVER

NOTE: FIELD SURVEYS AND RIGHT-OF-WAY CENTERLINES / MARGINS SHOWN ARE NOT NECESSARILY COMPLETE OR ACCURATE AND ARE BASED UPON A COMBINATION OF BEST AVAILABLE GIS DATA AND PARTIAL SURVEY INFORMATION.

0 100 200 400 600
SCALE IN FEET

EXIST SD PIPE

DOWNSTREAM FLOW PATH/ OPEN CHANNEL

K:\PROJECTS\WENATCHEE\18113-CONF PARKWAY\DESIGN\Drawings\Working\Drainage\Fig4 SWM Map-EA.dwg 9/23/2020 9:37 AM

City of Wenatchee

FIGURE 4B. PROJECT AREA DRAINAGE CONCEPTS, BASINS E - G

CONFLUENCE PARKWAY SR 285 BYPASS

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Wenatchee, WA 98801
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APPENDIX A – Stormwater Requirements Flowcharts

- **SWMMEW Figure 2.1**
- **SWMMEW Figure 2.2**
- **SWMMEW Figure 2.3**

Figure 2.1: Flow Chart for Determining Applicable Core Elements for New Development Projects

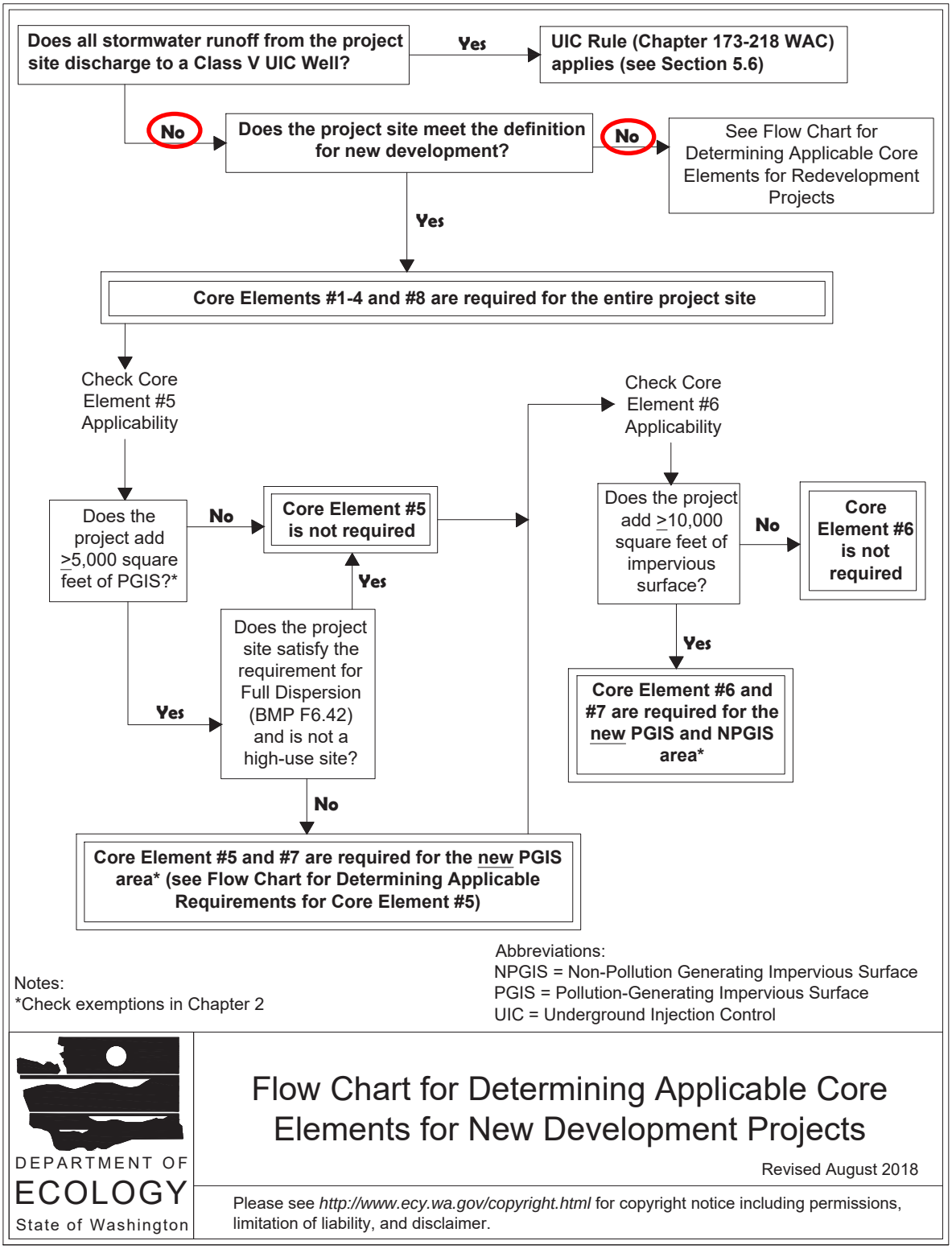


Figure 2.2: Flow Chart for Determining Applicable Core Elements for Redevelopment Projects

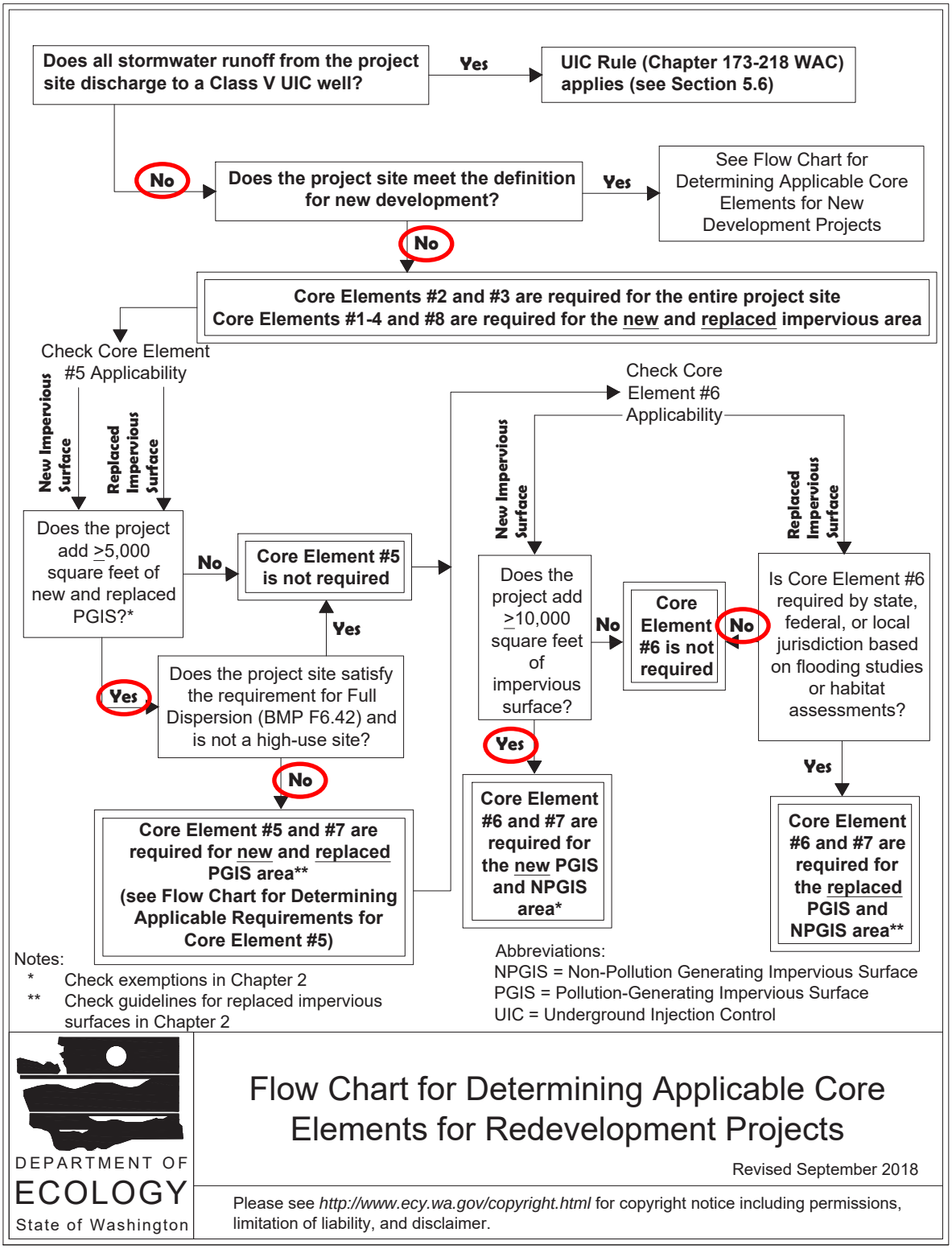
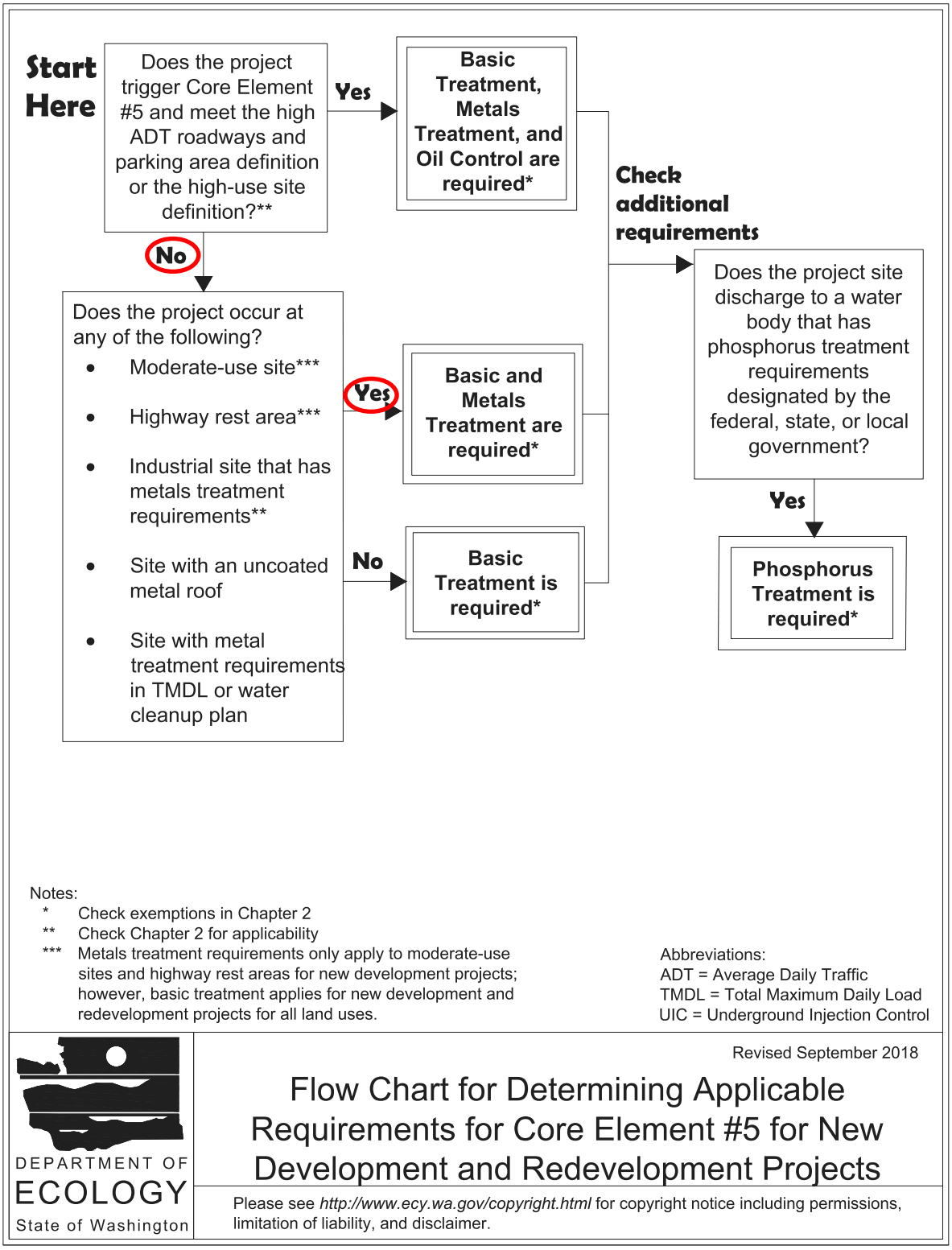
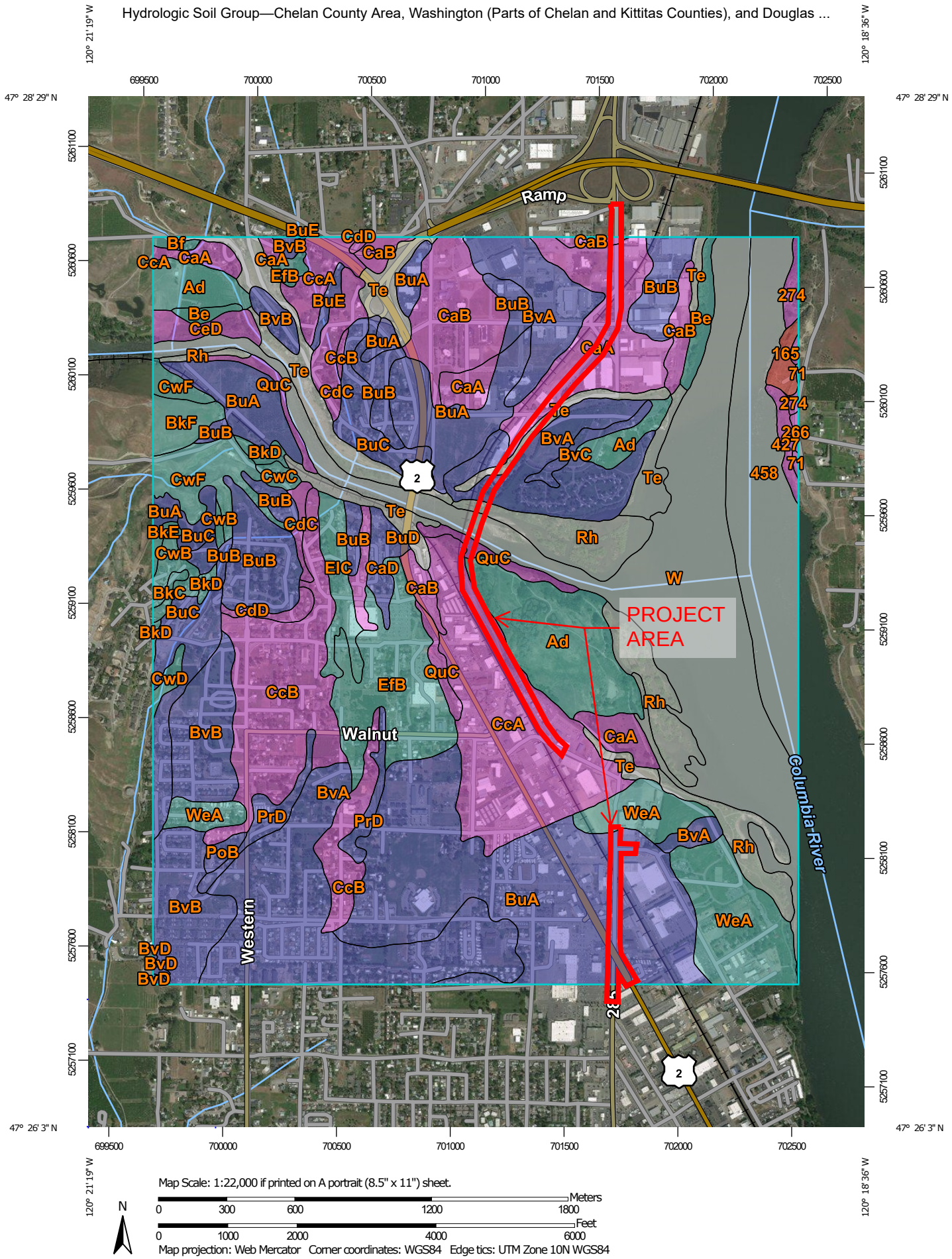


Figure 2.3: Flow Chart for Determining Applicable Requirements for Core Element #5 for New Development and Redevelopment Projects



APPENDIX B – USDA Soil Map


120° 21' 19" W
120° 18' 36" W
47° 28' 29" N
47° 26' 3" N
699500
700000
700500
701000
701500
702000
702500
5261100
5260600
5260100
5259600
5259100
5258600
5258100
5257600
5257100
Ramp
PROJECT AREA
Walnut
Western
Columbia River
2
Map Scale: 1:22,000 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0 300 600 1200 1800
Feet
0 1000 2000 4000 6000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:12,000 to 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chelan County Area, Washington (Parts of Chelan and Kittitas Counties)
Survey Area Data: Version 14, Sep 10, 2018

Soil Survey Area: Douglas County, Washington
Survey Area Data: Version 20, Sep 10, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 24, 2012—Sep 21, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ad	Alluvial land	C	99.4	4.3%
Be	Beverly fine sandy loam	C	14.3	0.6%
Bf	Beverly gravelly fine sandy loam	C	2.1	0.1%
BkC	Bjork silt loam, 8 to 15 percent slopes	C	2.6	0.1%
BkD	Bjork silt loam, 15 to 25 percent slopes	C	6.4	0.3%
BkE	Bjork silt loam, 25 to 45 percent slopes	C	2.5	0.1%
BkF	Bjork silt loam, 45 to 65 percent slopes	C	14.0	0.6%
BuA	Burch fine sandy loam, 0 to 3 percent slopes	B	312.2	13.6%
BuB	Burch fine sandy loam, 3 to 8 percent slopes	B	89.8	3.9%
BuC	Burch fine sandy loam, 8 to 15 percent slopes	B	65.2	2.8%
BuD	Burch fine sandy loam, 15 to 25 percent slopes	B	11.6	0.5%
BuE	Burch fine sandy loam, 25 to 45 percent slopes	B	4.6	0.2%
BvA	Burch loam, 0 to 3 percent slopes	B	241.0	10.5%
BvB	Burch loam, 3 to 8 percent slopes	B	92.5	4.0%
BvC	Burch loam, 8 to 15 percent slopes	B	7.0	0.3%
BvD	Burch loam, 15 to 25 percent slopes	B	0.7	0.0%
CaA	Cashmere sandy loam, 0 to 3 percent slopes	A	99.3	4.3%
CaB	Cashmere sandy loam, 3 to 8 percent slopes	A	71.9	3.1%
CaD	Cashmere sandy loam, 15 to 25 percent slopes	A	6.8	0.3%
CcA	Cashmont sandy loam, 0 to 3 percent slopes	A	146.9	6.4%
CcB	Cashmont sandy loam, 3 to 8 percent slopes	A	118.5	5.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CdC	Cashmont gravelly sandy loam, 8 to 15 percent slopes	A	20.7	0.9%
CdD	Cashmont gravelly sandy loam, 15 to 25 percent slopes	A	6.1	0.3%
CeD	Cashmont stony sandy loam, 0 to 25 percent slopes	A	11.8	0.5%
CwB	Cowiche silt loam, 3 to 8 percent slopes	C	10.3	0.4%
CwC	Cowiche silt loam, 8 to 15 percent slopes	C	3.9	0.2%
CwD	Cowiche silt loam, 15 to 25 percent slopes	C	3.9	0.2%
CwF	Cowiche silt loam, 45 to 65 percent slopes	C	34.9	1.5%
EfB	Ellisforde fine sandy loam, 3 to 8 percent slopes	C	74.0	3.2%
ElC	Ellisforde silt loam, 8 to 15 percent slopes	C	20.5	0.9%
PoB	Pogue fine sandy loam, 3 to 8 percent slopes	B	3.9	0.2%
PrD	Pogue gravelly fine sandy loam, 15 to 25 percent slopes	B	19.5	0.8%
QuC	Quincy loamy fine sand, 0 to 15 percent slopes	A	20.1	0.9%
Rh	Riverwash		82.0	3.6%
Te	Terrace escarpments		91.8	4.0%
W	Water		262.2	11.4%
WeA	Wenatchee silt loam, 0 to 3 percent slopes	C	89.2	3.9%
Subtotals for Soil Survey Area			**2,164.1**	**94.0%**
Totals for Area of Interest			**2,301.5**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Burbank loamy fine sand, 0 to 8 percent slopes	A	0.8	0.0%
165	Entiat-Rock outcrop-Torriorthents complex, 30 to 70 percent slopes	D	6.4	0.3%
266	Pogue cobbly fine sandy loam, 0 to 15 percent slopes	A	1.0	0.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
274	Quincy loamy fine sand, 0 to 15 percent slopes	A	6.4	0.3%
427	Torriorthents, very steep	A	6.5	0.3%
458	Water		116.3	5.1%
Subtotals for Soil Survey Area			**137.4**	**6.0%**
Totals for Area of Interest			**2,301.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C – Preliminary Stormwater Facility Sizing Calculations

- **Basin C & D Detention Pond Sizing Calculation**
- **Basin F Detention Pond Sizing Calculation**
- **Basin G Detention Pond Sizing Calculation**

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.005	5	1440	70	------	------	------	Existing C & D
2	SBUH Runoff	0.721	5	480	12,057	------	------	------	Proposed C & D
3	Reservoir	0.007	5	1485	3,790	2	102.61	11,847	Pond Flow

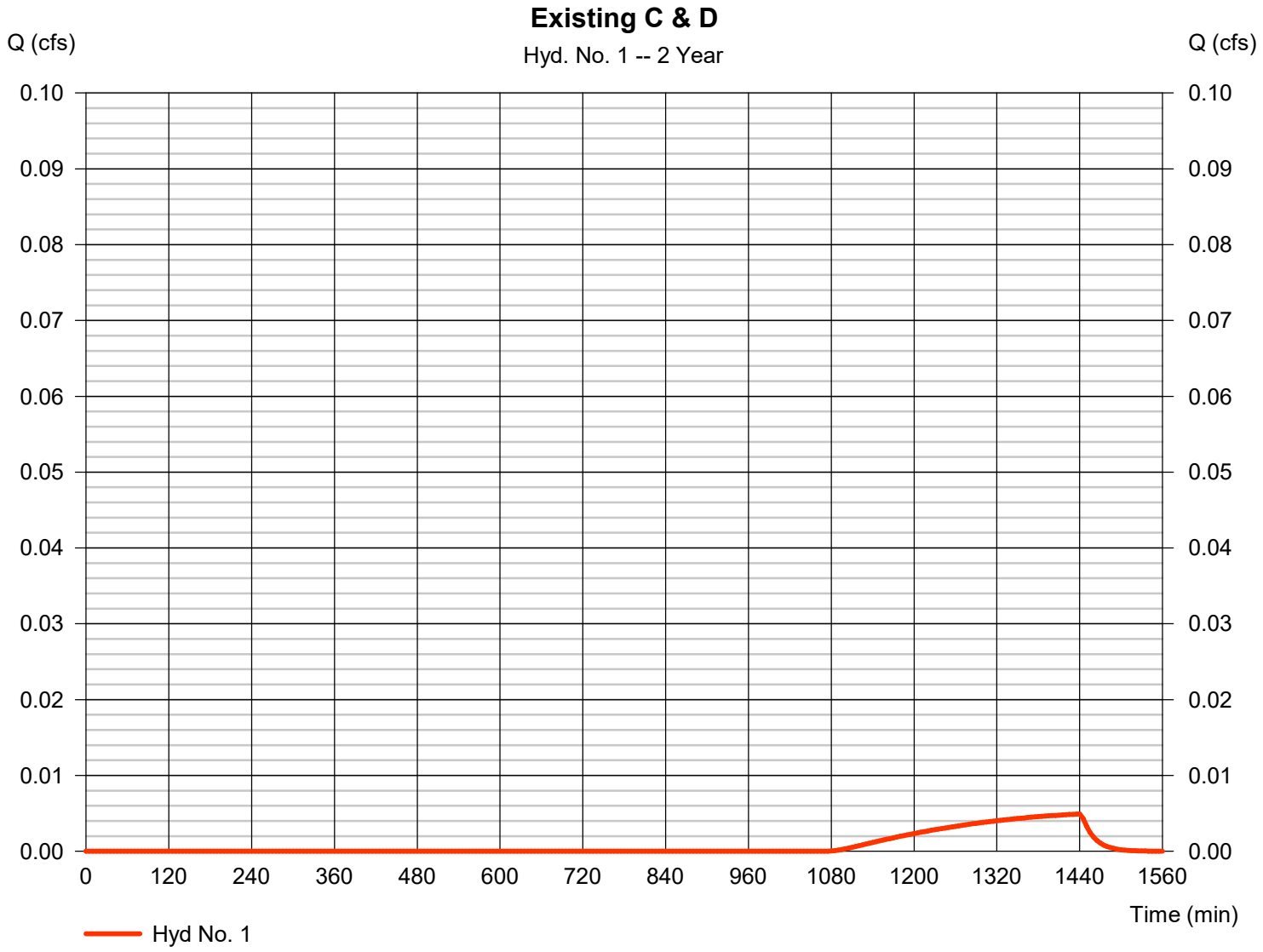
Hydrograph Report

Hyd. No. 1

Existing C & D

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.005 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 5 min	Hyd. volume	= 70 cuft
Drainage area	= 3.740 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(3.030 x 49) + (9.390 x 49)] / 3.740



TR55 Tc Worksheet

Hyd. No. 1

Existing C & D

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 83.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.10		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 10.91**	**+**	**0.00**	**+**	**0.00**	**=**	**10.91**
Shallow Concentrated Flow							
Flow length (ft)	= 964.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 7.04**	**+**	**0.00**	**+**	**0.00**	**=**	**7.04**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 18.00 min

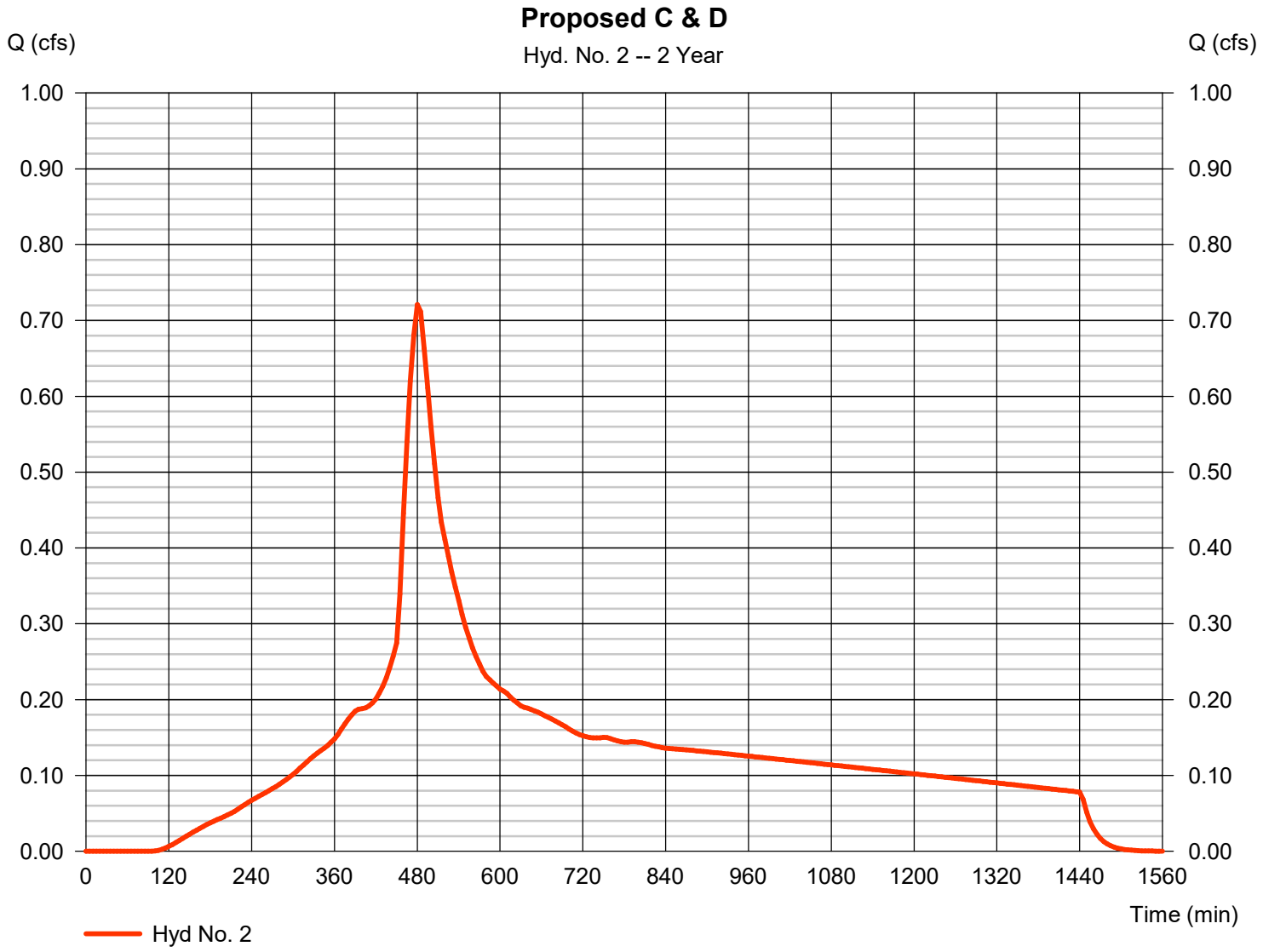
Hydrograph Report

Hyd. No. 2

Proposed C & D

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.721 cfs
Storm frequency	=	2 yrs	Time to peak	=	480 min
Time interval	=	5 min	Hyd. volume	=	12,057 cuft
Drainage area	=	3.740 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.00 min
Total precip.	=	1.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(1.220 x 98) + (1.810 x 84) + (4.330 x 98) + (5.060 x 84)] / 3.740



TR55 Tc Worksheet

Hyd. No. 2

Proposed C & D

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 83.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.10		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 10.91**	**+**	**0.00**	**+**	**0.00**	**=**	**10.91**
Shallow Concentrated Flow							
Flow length (ft)	= 964.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 7.04**	**+**	**0.00**	**+**	**0.00**	**=**	**7.04**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 18.00 min

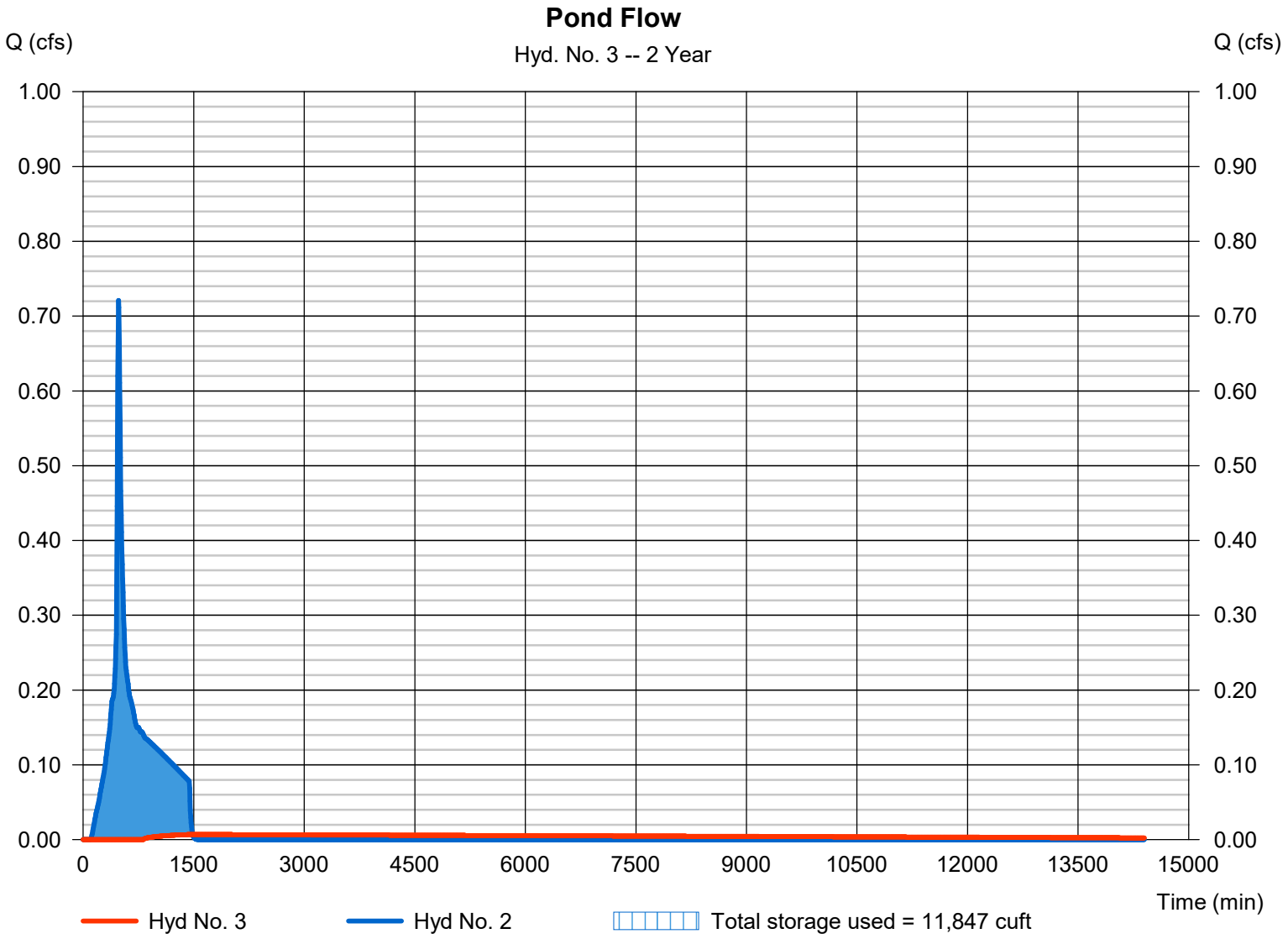
Hydrograph Report

Hyd. No. 3

Pond Flow

Hydrograph type	= Reservoir	Peak discharge	= 0.007 cfs
Storm frequency	= 2 yrs	Time to peak	= 1485 min
Time interval	= 5 min	Hyd. volume	= 3,790 cuft
Inflow hyd. No.	= 2 - Proposed C & D	Max. Elevation	= 102.61 ft
Reservoir name	= Detention Pond	Max. Storage	= 11,847 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Detention Pond

Pond Data

Trapezoid -Bottom L x W = 72.0 x 72.0 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 4.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	5,184	0	0
0.40	100.40	5,535	2,143	2,143
0.80	100.80	5,898	2,286	4,430
1.20	101.20	6,273	2,434	6,864
1.60	101.60	6,659	2,586	9,449
2.00	102.00	7,056	2,743	12,192
2.40	102.40	7,465	2,904	15,096
2.80	102.80	7,885	3,070	18,166
3.20	103.20	8,317	3,240	21,406
3.60	103.60	8,761	3,415	24,821
4.00	104.00	9,216	3,595	28,416

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.55	Inactive	0.00
Span (in)	= 12.00	0.55	0.50	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	101.84	102.00	0.00
Length (ft)	= 25.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

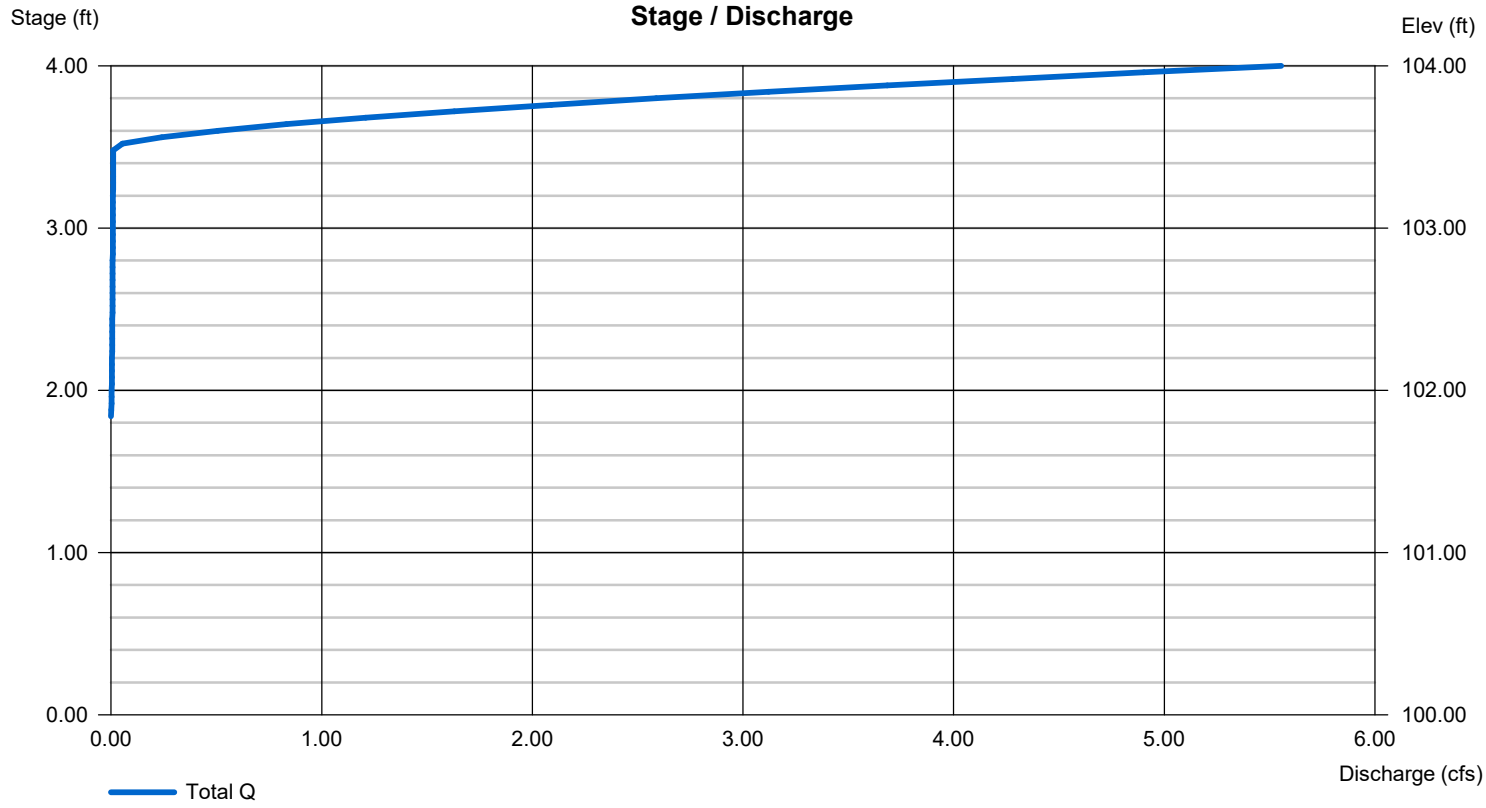
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.71	Inactive	0.00	0.00
Crest El. (ft)	= 103.50	102.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.059	5	1105	2,824	------	------	------	Existing C & D
2	SBUH Runoff	1.461	5	480	24,627	------	------	------	Proposed C & D
3	Reservoir	0.244	5	930	13,946	2	103.51	17,248	Pond Flow

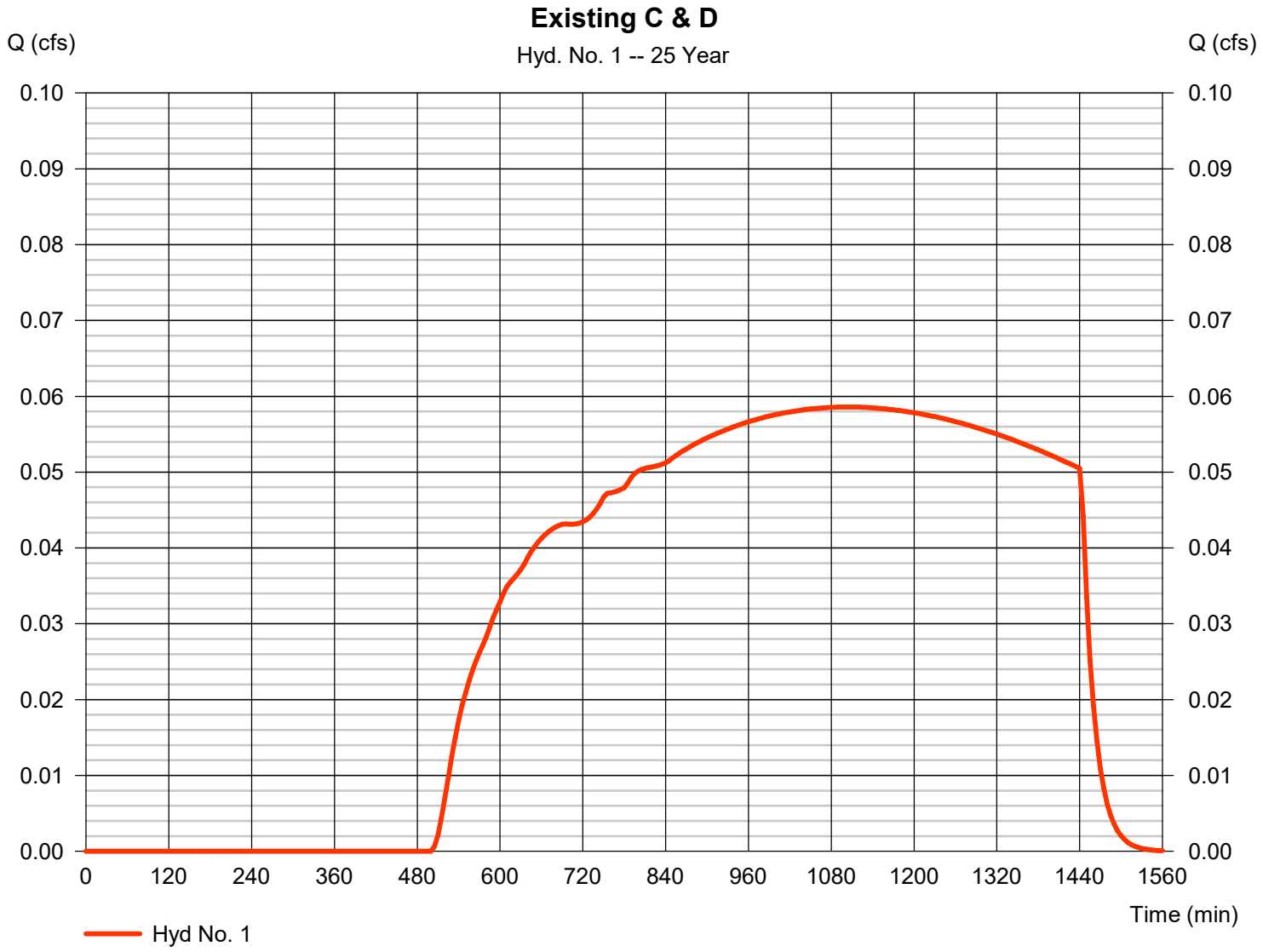
Hydrograph Report

Hyd. No. 1

Existing C & D

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.059 cfs
Storm frequency	= 25 yrs	Time to peak	= 1105 min
Time interval	= 5 min	Hyd. volume	= 2,824 cuft
Drainage area	= 3.740 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 2.04 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(3.030 x 49) + (9.390 x 49)] / 3.740



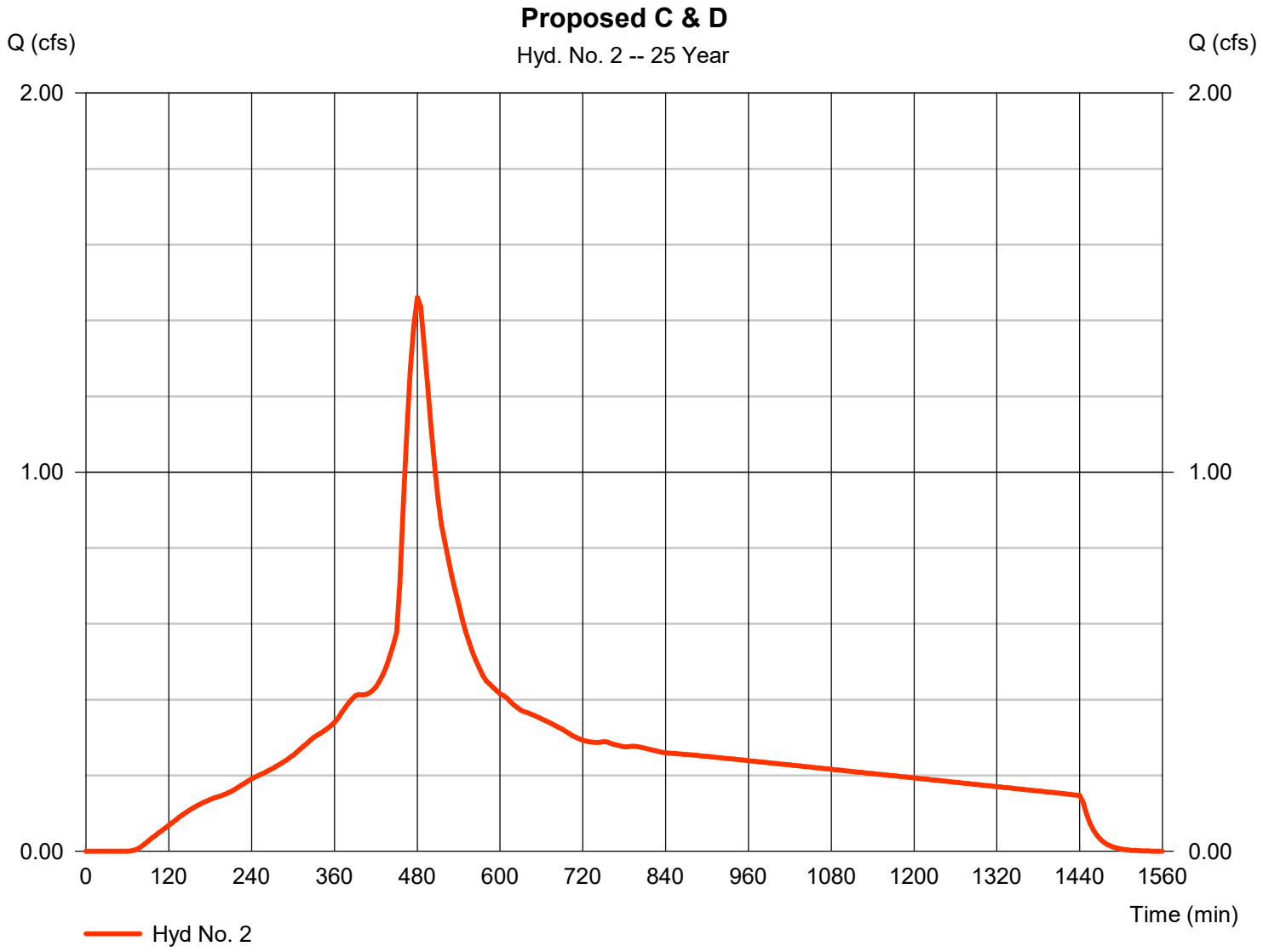
Hydrograph Report

Hyd. No. 2

Proposed C & D

Hydrograph type	=	SBUH Runoff	Peak discharge	=	1.461 cfs
Storm frequency	=	25 yrs	Time to peak	=	480 min
Time interval	=	5 min	Hyd. volume	=	24,627 cuft
Drainage area	=	3.740 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.00 min
Total precip.	=	2.04 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(1.220 x 98) + (1.810 x 84) + (4.330 x 98) + (5.060 x 84)] / 3.740



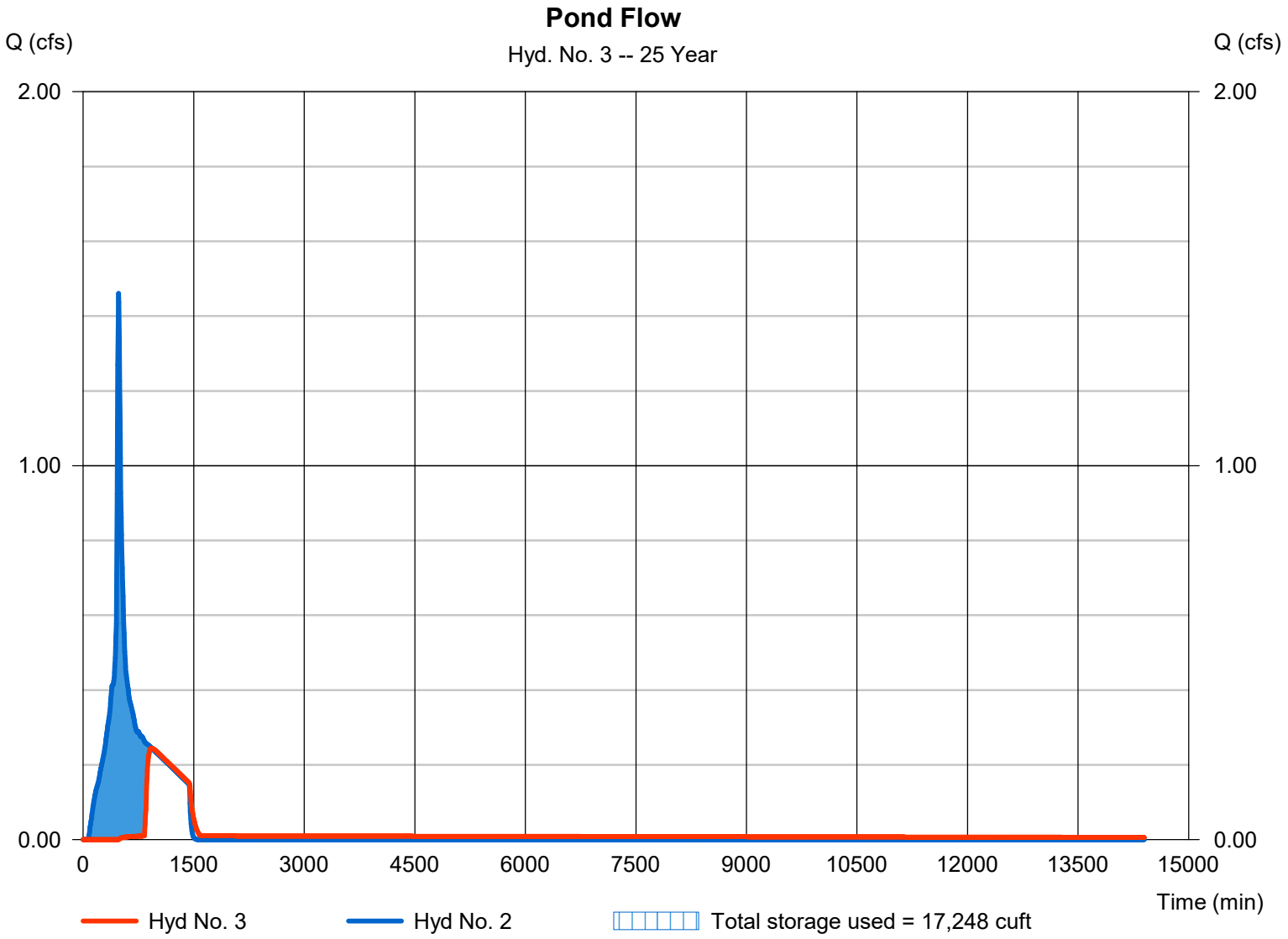
Hydrograph Report

Hyd. No. 3

Pond Flow

Hydrograph type	=	Reservoir	Peak discharge	=	0.244 cfs
Storm frequency	=	25 yrs	Time to peak	=	930 min
Time interval	=	5 min	Hyd. volume	=	13,946 cuft
Inflow hyd. No.	=	2 - Proposed C & D	Max. Elevation	=	103.51 ft
Reservoir name	=	Detention Pond	Max. Storage	=	17,248 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.002	5	1440	33	------	------	------	Existing Basin F
2	SBUH Runoff	0.402	5	475	5,641	------	------	------	Proposed Basin F
3	Reservoir	0.004	5	1455	1,233	2	102.81	5,552	Pond Flow

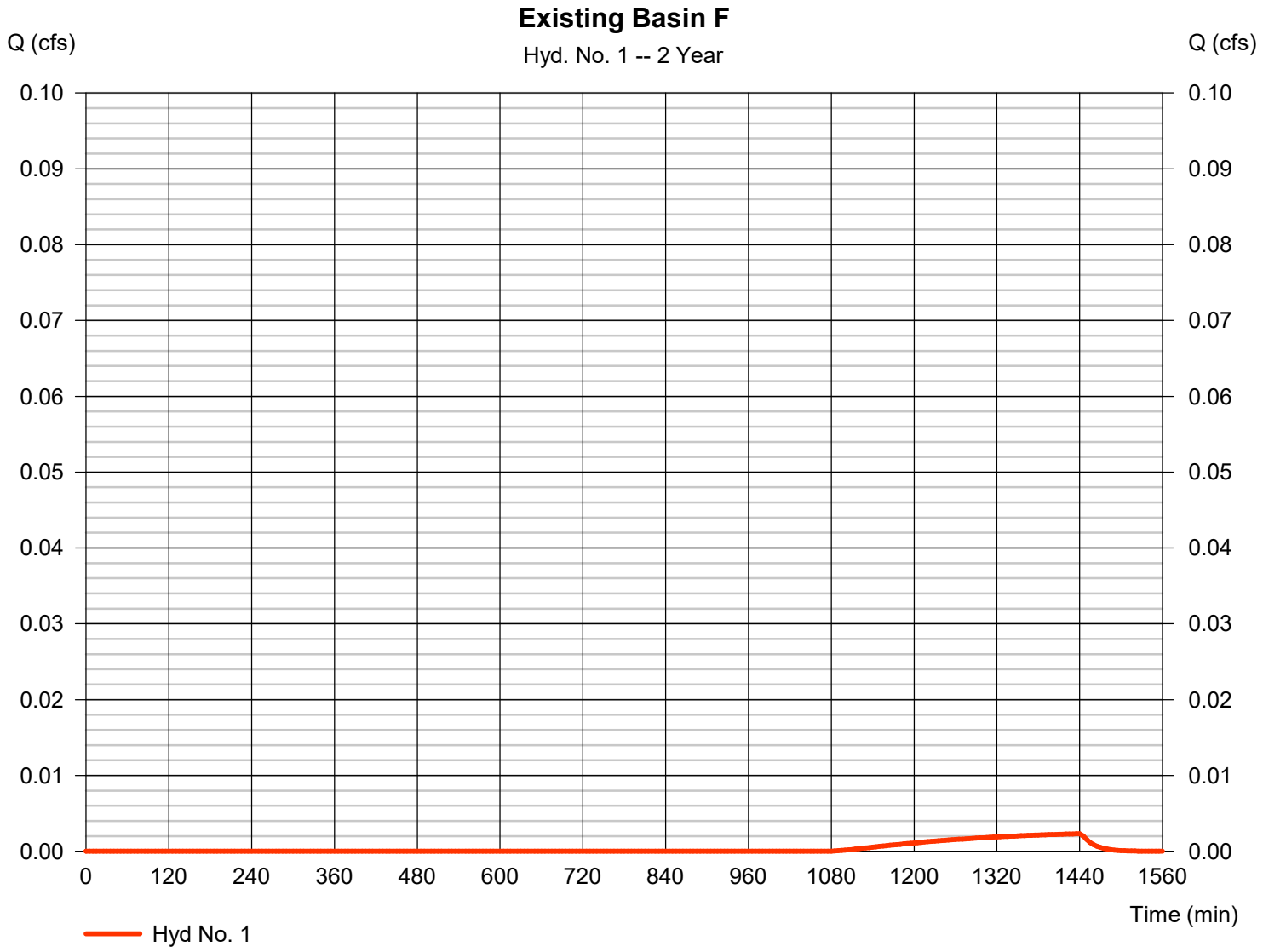
Hydrograph Report

Hyd. No. 1

Existing Basin F

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.002 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 5 min	Hyd. volume	= 33 cuft
Drainage area	= 1.750 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.10 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(3.030 x 49) + (9.390 x 49)] / 1.750



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 1

Existing Basin F

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 75.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.10		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 13.28**	**+**	**0.00**	**+**	**0.00**	**=**	**13.28**
Shallow Concentrated Flow							
Flow length (ft)	= 665.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 4.86**	**+**	**0.00**	**+**	**0.00**	**=**	**4.86**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 18.10 min

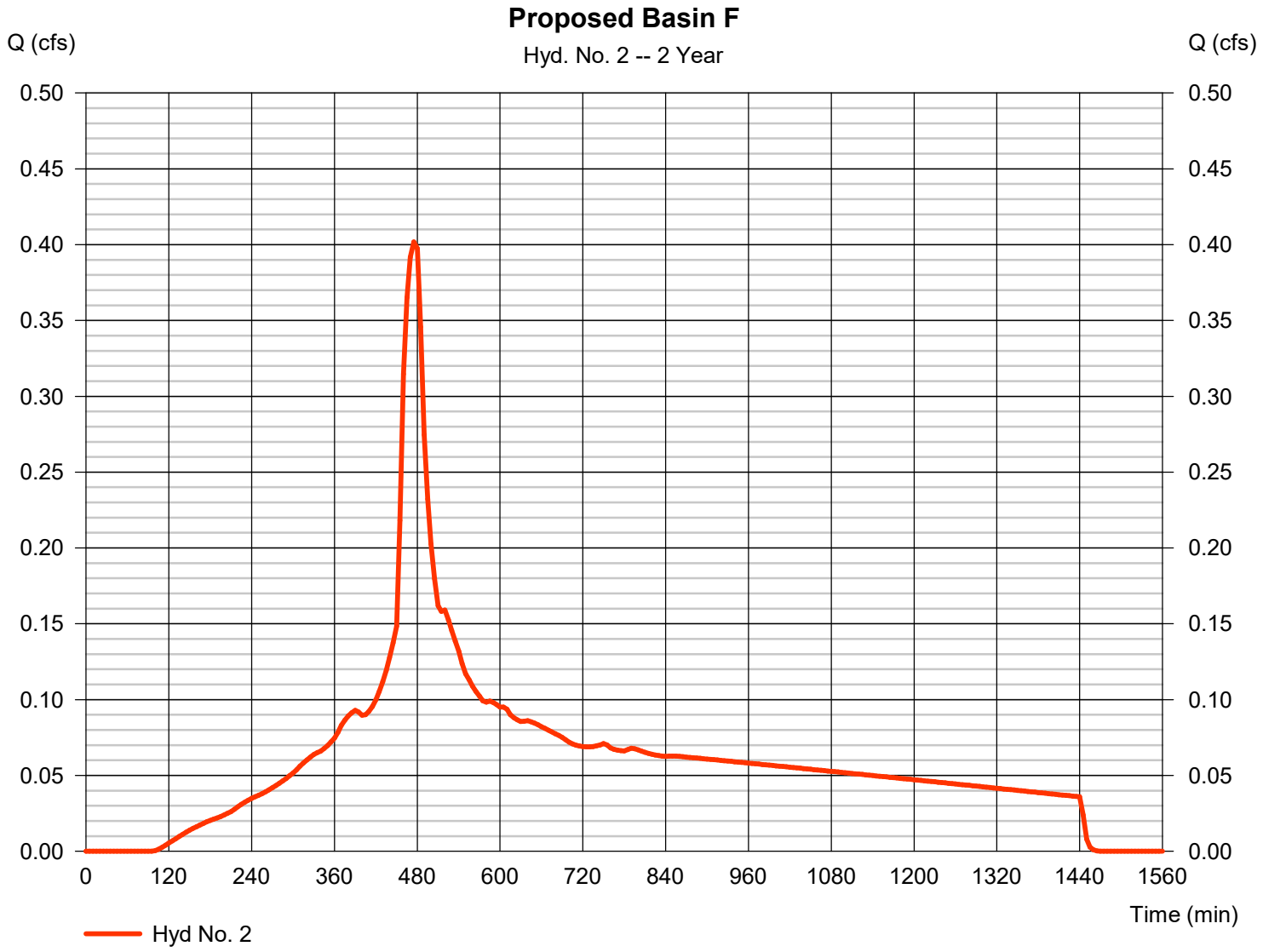
Hydrograph Report

Hyd. No. 2

Proposed Basin F

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.402 cfs
Storm frequency	=	2 yrs	Time to peak	=	475 min
Time interval	=	5 min	Hyd. volume	=	5,641 cuft
Drainage area	=	1.750 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	1.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(1.220 x 98) + (1.810 x 84) + (4.330 x 98) + (5.060 x 84)] / 1.750



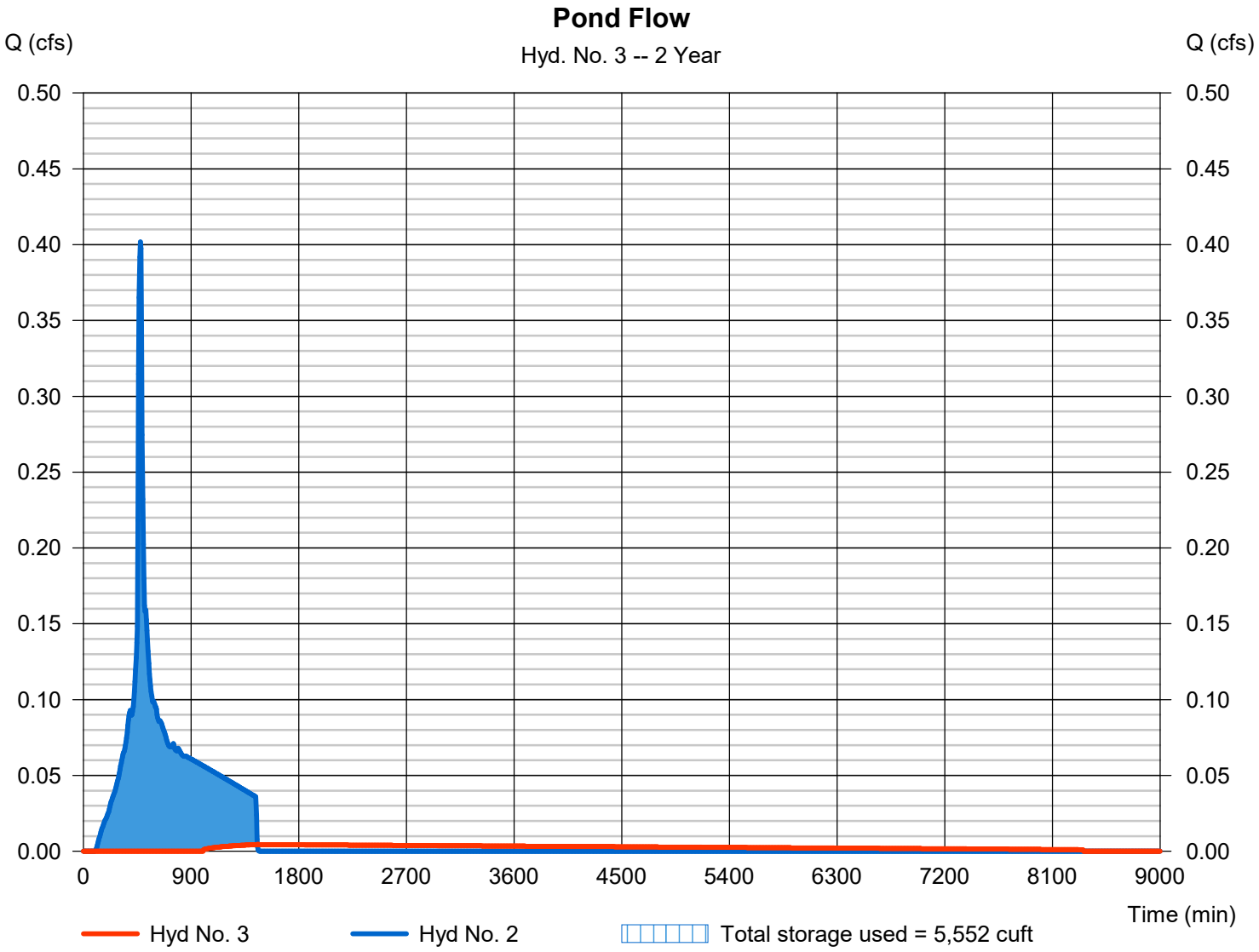
Hydrograph Report

Hyd. No. 3

Pond Flow

Hydrograph type	= Reservoir	Peak discharge	= 0.004 cfs
Storm frequency	= 2 yrs	Time to peak	= 1455 min
Time interval	= 5 min	Hyd. volume	= 1,233 cuft
Inflow hyd. No.	= 2 - Proposed Basin F	Max. Elevation	= 102.81 ft
Reservoir name	= Detention Pond	Max. Storage	= 5,552 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Detention Pond

Pond Data

Trapezoid -Bottom L x W = 45.7 x 45.5 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 4.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	2,078	0	0
0.40	100.40	2,302	876	876
0.80	100.80	2,538	968	1,843
1.20	101.20	2,786	1,064	2,908
1.60	101.60	3,045	1,166	4,073
2.00	102.00	3,315	1,272	5,345
2.40	102.40	3,598	1,382	6,727
2.80	102.80	3,891	1,497	8,225
3.20	103.20	4,196	1,617	9,842
3.60	103.60	4,513	1,742	11,583
4.00	104.00	4,841	1,871	13,454

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.50	Inactive	0.00
Span (in)	= 12.00	0.50	0.50	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	102.33	102.00	0.00
Length (ft)	= 25.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.71	Inactive	0.00	0.00
Crest El. (ft)	= 103.53	102.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	100.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.40	876	100.40	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.80	1,843	100.80	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.20	2,908	101.20	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
1.60	4,073	101.60	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.00	5,345	102.00	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
2.40	6,727	102.40	0.00 oc	0.00 ic	0.00	---	0.00	0.00	---	---	---	---	0.001
2.80	8,225	102.80	0.00 ic	0.00 ic	0.00	---	0.00	0.00	---	---	---	---	0.004
3.20	9,842	103.20	0.01 ic	0.01 ic	0.00	---	0.00	0.00	---	---	---	---	0.006
3.60	11,583	103.60	0.30 oc	0.01 ic	0.00	---	0.29	0.00	---	---	---	---	0.298
4.00	13,454	104.00	5.06 oc	0.01 ic	0.00	---	5.05	0.00	---	---	---	---	5.062

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.027	5	1105	1,321	------	------	------	Existing Basin F
2	SBUH Runoff	0.811	5	475	11,523	------	------	------	Proposed Basin F
3	Reservoir	0.106	5	1010	6,906	2	103.82	8,744	Pond Flow

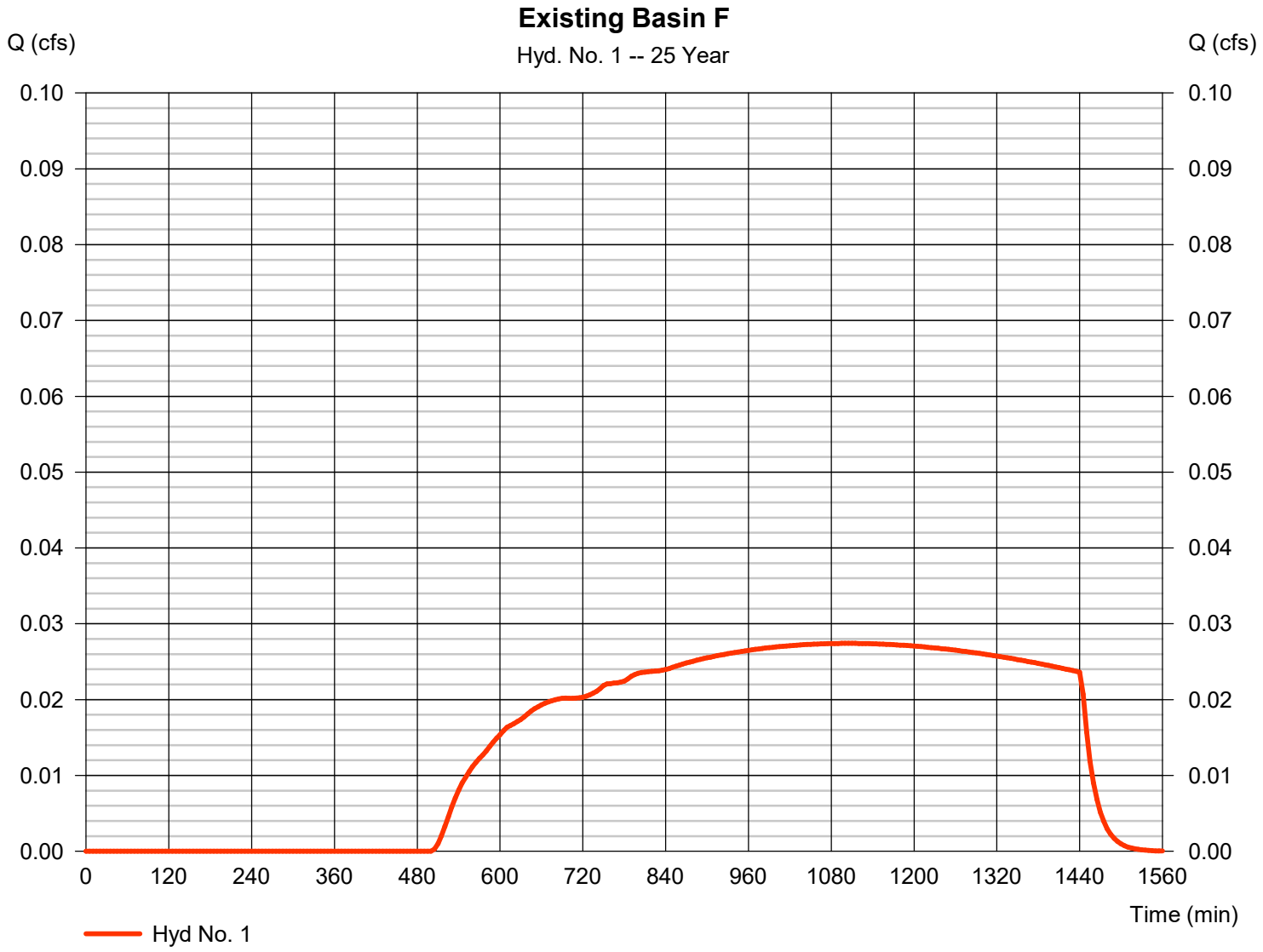
Hydrograph Report

Hyd. No. 1

Existing Basin F

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.027 cfs
Storm frequency	= 25 yrs	Time to peak	= 1105 min
Time interval	= 5 min	Hyd. volume	= 1,321 cuft
Drainage area	= 1.750 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.10 min
Total precip.	= 2.04 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(3.030 x 49) + (9.390 x 49)] / 1.750



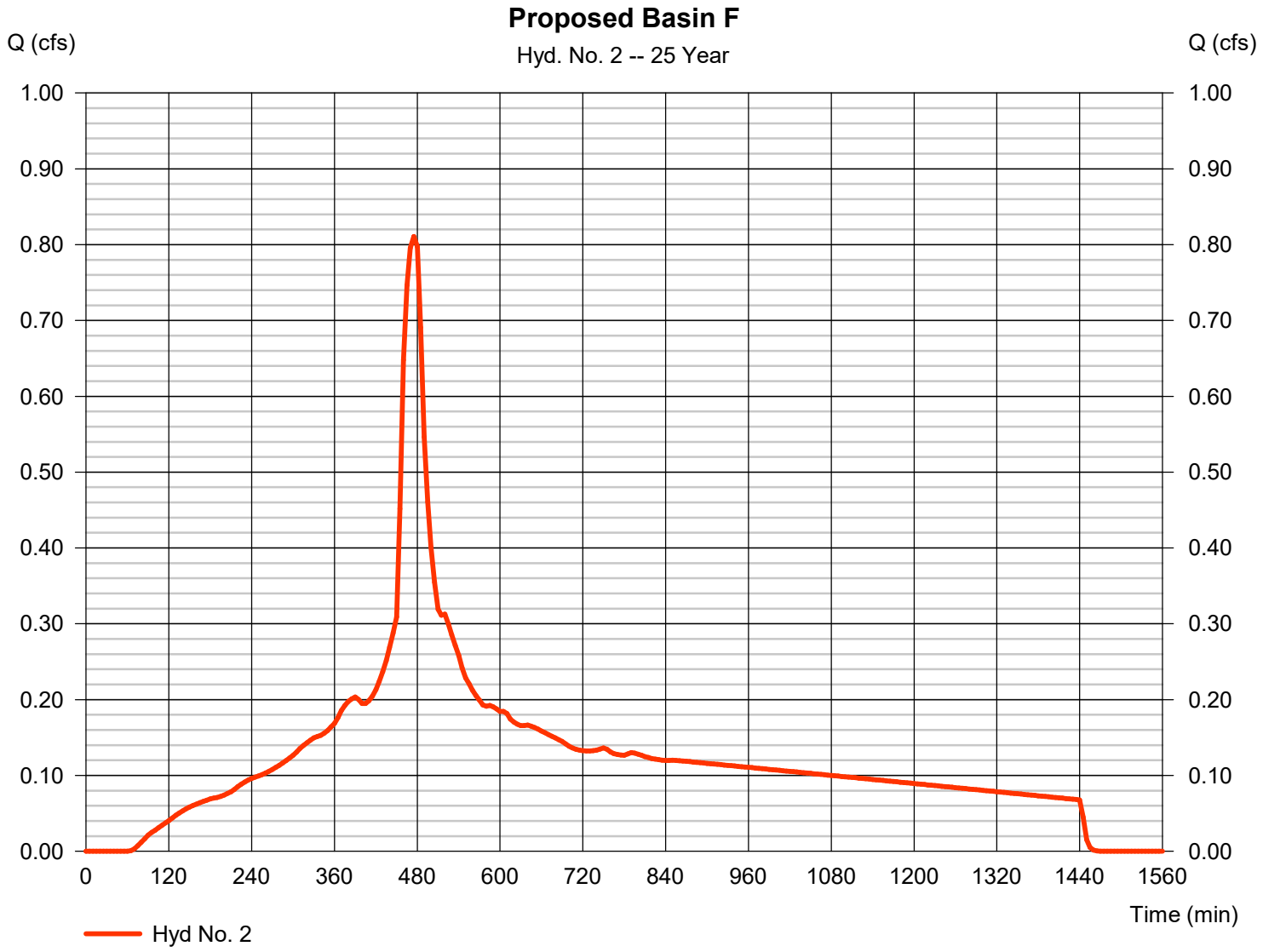
Hydrograph Report

Hyd. No. 2

Proposed Basin F

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.811 cfs
Storm frequency	=	25 yrs	Time to peak	=	475 min
Time interval	=	5 min	Hyd. volume	=	11,523 cuft
Drainage area	=	1.750 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.04 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(1.220 x 98) + (1.810 x 84) + (4.330 x 98) + (5.060 x 84)] / 1.750



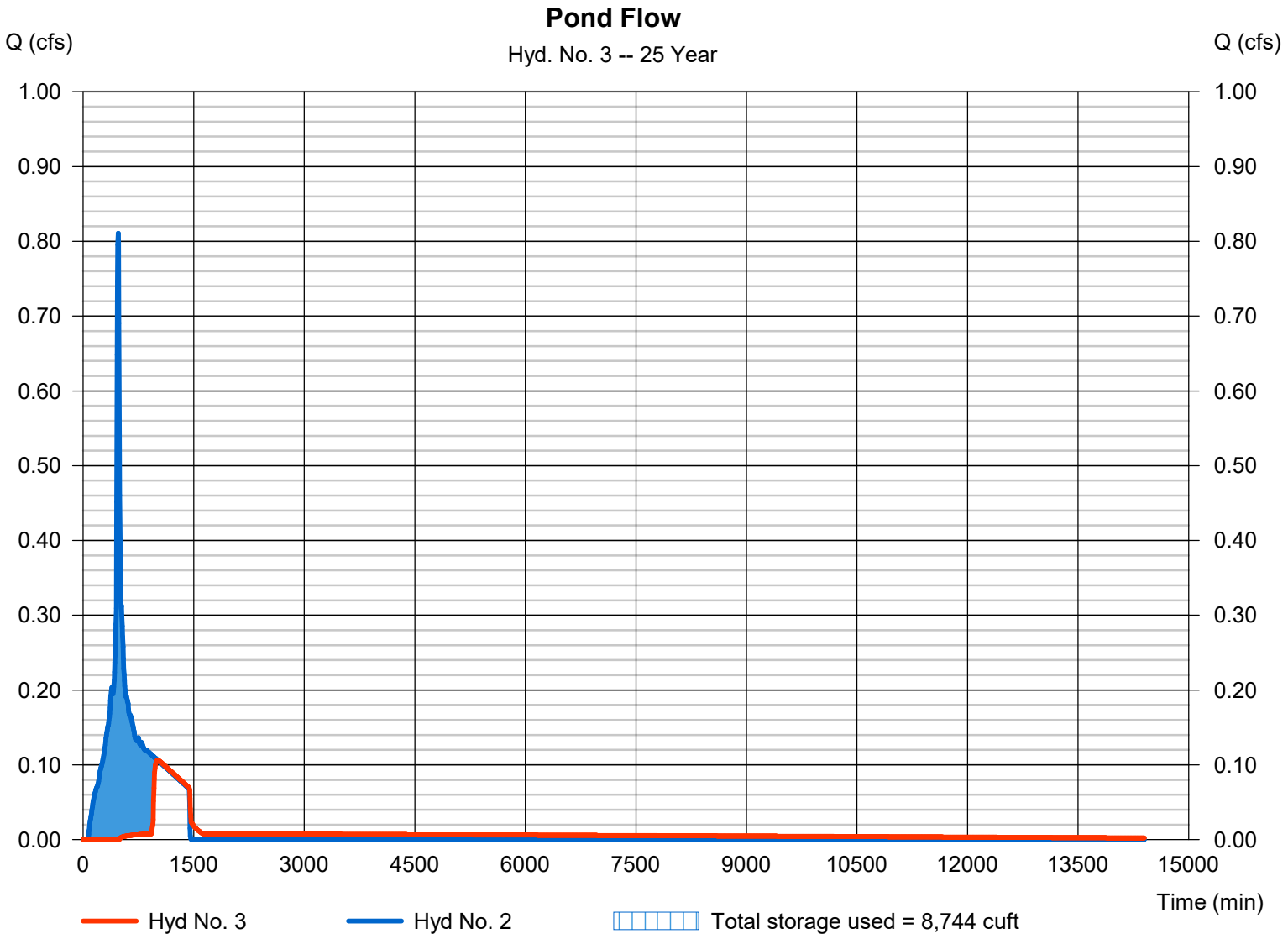
Hydrograph Report

Hyd. No. 3

Pond Flow

Hydrograph type	= Reservoir	Peak discharge	= 0.106 cfs
Storm frequency	= 25 yrs	Time to peak	= 1010 min
Time interval	= 5 min	Hyd. volume	= 6,906 cuft
Inflow hyd. No.	= 2 - Proposed Basin F	Max. Elevation	= 103.82 ft
Reservoir name	= Detention Pond	Max. Storage	= 8,744 cuft

Storage Indication method used.



Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SBUH Runoff	------	-------	0.000	-------	-------	-------	0.003	-------	-------	Existing Basin G
2	SBUH Runoff	------	-------	0.039	-------	-------	-------	0.079	-------	-------	Proposed Basin G
3	Reservoir	2	-------	0.023	-------	-------	-------	0.300	-------	-------	Pond Flow

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.000	5	1440	3	------	------	------	Existing Basin G
2	SBUH Runoff	0.039	5	475	548	------	------	------	Proposed Basin G
3	Reservoir	0.023	5	855	1,704	2	103.80	1,193	Pond Flow

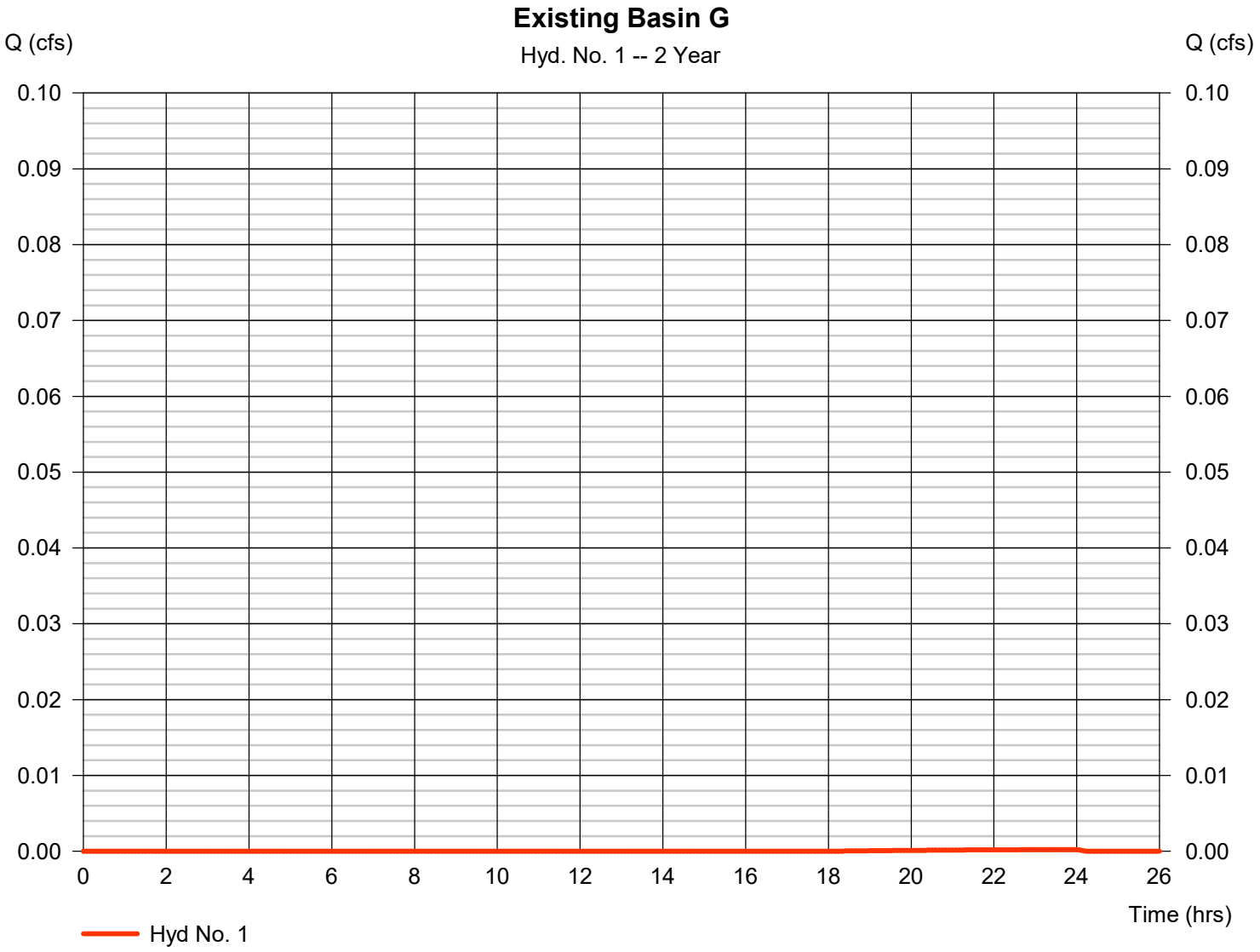
Hydrograph Report

Hyd. No. 1

Existing Basin G

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 24.00 hrs
Time interval	= 5 min	Hyd. volume	= 3 cuft
Drainage area	= 0.170 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = + (0.650 x 61)] / 0.170



TR55 Tc Worksheet

Hyd. No. 1

Existing Basin G

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 15.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.10		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 3.66**	**+**	**0.00**	**+**	**0.00**	**=**	**3.66**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 5.00 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.003	5	1090	128	------	------	------	Existing Basin G
2	SBUH Runoff	0.079	5	475	1,119	------	------	------	Proposed Basin G
3	Reservoir	0.300	5	480	3,889	2	103.86	1,239	Pond Flow

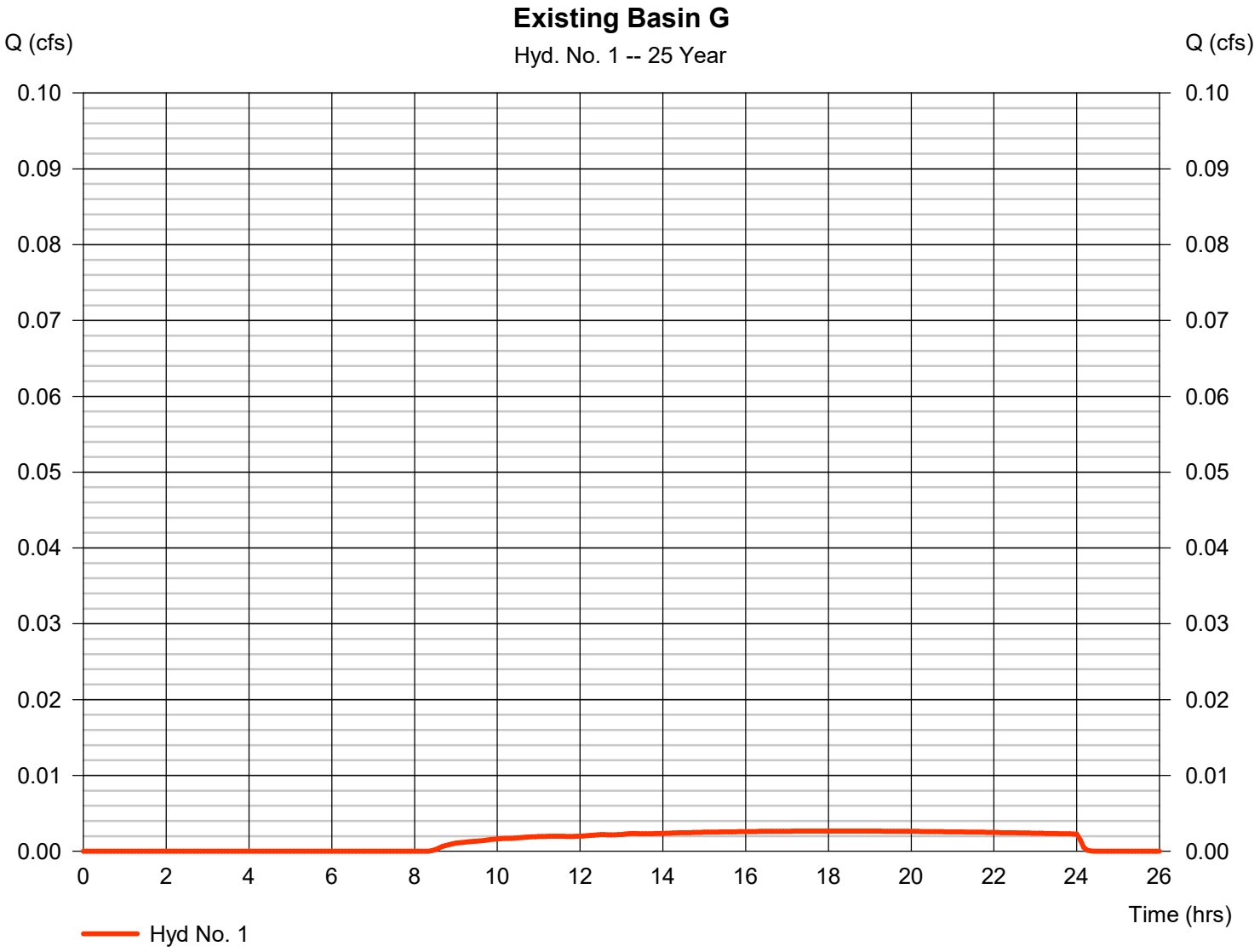
Hydrograph Report

Hyd. No. 1

Existing Basin G

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.003 cfs
Storm frequency	= 25 yrs	Time to peak	= 18.17 hrs
Time interval	= 5 min	Hyd. volume	= 128 cuft
Drainage area	= 0.170 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.04 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = + (0.650 x 61)] / 0.170



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

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Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	1.10	0.00	1.50	1.80	2.04	2.40	2.60
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00